United States of America

Confidence Building Measure Return covering 2019

Convention on the Prohibition of the Development, Production and Stockpiling of
Bacteriological (Biological) and Toxin Weapons and on their Destruction

Submitted to the United Nations on
April 15, 2020

Declaration form on Nothing to Declare or Nothing New to Declare for use in the information exchange

Measure	Nothing to declare	Nothing new to declare	Year of last declaration if nothing new to declare
A, part 1			
A, part 2 (i)			
A, part 2 (ii)			
A, part 2 (iii)			
B			
C			
E			
F		√	1997
G			

Date: April 15, 2020

State Party to the Convention: United States of America

Date of ratification/accession to the Convention: March 26, 1975

National point of contact: Mr. Christopher Park, Department of State

Inquiries may be directed to ISN-BPS-DL@state.gov.

Report of the United States of America to the United Nations Department for Disarmament Affairs

Pursuant to the procedural modalities agreed upon in April 1987 at the "Ad Hoc Meeting of Scientific and Technical Experts for States Parties to the Convention on the Prohibition of the Development, Production, and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on Their Destruction," the United States of America submits the following information under Article V of the Convention:

Confidence Building Measure A, Part 1

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Confidence Building Measure A, Part 2

Exchanges of information on national biological defence research and development programmes

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Confidence Building Measure B

Exchange of information on outbreaks of infectious diseases and similar occurrences caused by toxins page 138

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Encouragement of publication of results and promotion of use of knowledge page 143

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Declaration of past activities in offensive and/or defensive biological research and development programmes page 153

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Appendix A

List of the Biological Select Agents and Toxins, and NIAID Category A, B and C Priority Pathogens page 167

Appendix B

Compiled list of microorganisms and toxins used for biodefense research page 171

Form A, Part 1

BWC - Confidence Building Measure

Exchange of data on research centres and laboratories

United States of America

April 15, 2020

Form A, Part 1 (i)

Exchange of data on research centres and laboratories

1. Name(s) of facility.
National Biodefense Analysis and Countermeasures Center (NBACC)

2. Responsible public or private organization or company.
U.S. Department of Homeland Security Science and Technology Directorate
Operated by Battelle National Biodefense Institute LLC

3. Location and postal address.
8300 Research Plaza, Fort Detrick, Maryland 21702

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence.
U.S. Department of Homeland Security (DHS)
U.S. Department of Justice (DOJ)
U.S. Department of Health and Human Services (HHS)

5. Number of maximum containment units within the research centre and/or laboratory, with an indication of their respective size (m^2).

BSL 4 Laboratory	980 m^2

6. Scope and general description of activities, including type(s) of microorganisms and/or toxins as appropriate.
NBACC conducts studies to better understand current and future biological threats; to assess vulnerabilities; and to determine potential impacts to guide the development of biological countermeasures such as detectors, drugs, vaccines, and decontamination technologies. When needed, NBACC conducts experimental programs to better characterize the benefits and risks of changes in U.S. biodefense preparations. NBACC also develops bioforensic assays and provides operational bioforensic analysis to support the attribution of biocrime and bioterrorism. (http://bnbi.org/)

The types of agents registered for use at NBACC are BSL-2 toxins, BSL-2 gram positive and gram negative bacterial agents, BSL-2 viral agents, BSL-3 gram positive and gram negative bacterial agents, BSL-3 viral agents, and BSL-4 viral agents.

Exchange of data on research centres and laboratories

1. Name(s) of facility.
U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)

2. Responsible public or private organization or company.
U.S. Army Medical Research and Materiel Command

3. Location and postal address.
1425 Porter Street, Fort Detrick, Frederick, Maryland 21702-5011

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence.
U.S. Department of Defense (DoD) – Partly
U.S. Department of Homeland Security (DHS)
U.S. Department of Health and Human Services (DHHS)
U.S. Department of Agriculture (USDA)
U.S. Department of Energy (DoE)
U.S. Food and Drug Administration (FDA)
Universities
Private sector companies

5. Number of maximum containment units[3] within the research centre and/or laboratory, with an indication of their respective size (m^2).

BSL 4 Laboratory	1186 m^2

6. Scope and general description of activities, including type(s) of microorganisms and/or toxins as appropriate.
USAMRIID conducts research to develop strategies, products, information, procedures and training programs for medical defense against biological warfare threats and infectious diseases. Medical products developed to protect military personnel against biological agents include vaccines, drugs, diagnostic capabilities and various medical management procedures.

Additional information can be found at: http://www.usamriid.army.mil/

Exchange of data on research centres and laboratories

1. Name(s) of facility.
Centers for Disease Control (CDC), Deputy Director for Infectious Disease (DDID)

2. Responsible public or private organization or company.
Centers for Disease Control and Prevention (CDC), Department of Health and Human Services (HHS)

3. Location and postal address.
1600 Clifton Road N.E., Atlanta, Georgia, 30329

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence.
U.S. Department of Health and Human Services (HHS)

5. Number of maximum containment units[3] within the research centre and/or laboratory, with an indication of their respective size (m^2).

BSL-4 Laboratory	127 m^2
BSL-4 Laboratory	279 m^2
BSL-4 Laboratory	127 m^2

6. Scope and general description of activities, including type(s) of microorganisms and/or toxins as appropriate.
Activities include developing diagnostic assays for public health, developing and validating methods to differentiate and characterize organisms and the toxins that they produce, developing environmental sampling methods for recovery of agents from porous and nonporous surfaces for public health, routine reference antimicrobial susceptibility testing of clinical isolates, conducting molecular and antigenic characterization of organisms, determining pathogenicity and virulence of infectious agents, development of culture-independent point of care diagnostics, maintaining emergency response laboratory expertise and capacity, evaluating vaccines and medical countermeasures, determining the natural history of infectious organisms, assessing immune correlates of protection, and conducting epidemiologic studies and surveillance for diseases. Additional information can be found at: https://www.cdc.gov/ddid/. Please note, in 2019, 127 square meters of the reported BSL-4 space was utilized as BSL-3 Enhanced (BSL-3E) space, but remained capable of being used as BSL-4 space.

Biodefense activities include those with select agents (the select agents list is available at: http://www.selectagents.gov/SelectAgentsandToxinsList.html).

Form A, Part 1 (i)

Exchange of data on research centres and laboratories

1. Name(s) of facility

Integrated Research Facility at Fort Detrick (IRF – Frederick)

2. Responsible public or private organization or company

National Institutes of Health, Department of Health and Human Services
Operated by Battelle Memorial Institute

3. Location and postal address

8200 Research Plaza, Frederick, Maryland 21702

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence

Department of Health and Human Services (HHS)

5. Number of maximum containment units[3] within the research centre and/or laboratory, with an indication of their respective size (m^2)

BSL-4 Laboratory	1305 m^2

6. Scope and general description of activities, including type(s) of micro-organisms and/or toxins as appropriate

The Integrated Research Facility at Fort Detrick in Frederick, Maryland (IRF-Frederick) is a component of the Division of Clinical Research of the National Institute of Allergy and Infectious Diseases (NIAID) at the National Institutes of Health (NIH). The mission of the IRF-Frederick is to manage, coordinate, and facilitate the conduct of emerging infectious disease and biodefense research to develop vaccines, countermeasures, and improved medical outcomes for patients. Research emphasis is placed on elucidating the nature of high consequence pathogens. Additional information can be found at: https://www.niaid.nih.gov/about/dir.

Form A, Part 1 (i)

Exchange of data on research centres and laboratories

1. Name(s) of facility
Integrated Research Facility at Rocky Mountain Laboratories (IRF-RML)

2. Responsible public or private organization or company
National Institutes of Health (NIH), Department of Health and Human Services (HHS)

3. Location and postal address
903 South 4th Street, Hamilton, Montana 59840 United States

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence
Department of Health and Human Services (HHS)

5. Number of maximum containment units[3] within the research centre and/or laboratory, with an indication of their respective size (m^2)

BSL-4 Laboratory	1145 m^2

6. Scope and general description of activities, including type(s) of micro-organisms and/or toxins as appropriate
Rocky Mountain Laboratories (RML) is a component of the Division of Intramural Research of the National Institute of Allergy and Infectious Diseases (NIAID) at the National Institutes of Health (NIH). The RML mission is to play a leading role in the nation’s efforts to develop diagnostics, vaccines, and therapeutics to combat emerging and re-emerging infectious diseases. Research at the Integrated Research Facility at Rocky Mountain Laboratories (IRF-RML) is dedicated to understanding the mechanisms of pathogenesis of microbial agents associated with or likely to cause serious or lethal human diseases using molecular methods and animal model systems. Additional information can be found at: https://www.niaid.nih.gov/about/rocky-mountain-laboratories.

Exchange of data on research centres and laboratories

1. Name(s) of facility
Galveston National Laboratory (GNL) Complex including Robert E. Shope Laboratory

2. Responsible public or private organization or company
The University of Texas Medical Branch

3. **Location and postal address**
301 University Boulevard, Galveston, Texas 77555

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence
State of Texas and the University of Texas Medical Branch
U.S. Department of Agriculture (USDA)
Private Foundations
Pharmaceutical and Biotechnology Industries
U.S. Department of Energy (DOE)
U.S. Department of Defense (DOD) - Partly
U.S. Department of Homeland Security (DHS)
National Institutes of Health (NIH)
Centers for Disease Control and Prevention (CDC)

5. Number of maximum containment units within the research centre and/or laboratory, with an indication of their respective size (m^2)

BSL-4 Laboratory	186 m^2 (Shope Laboratory)
BSL-4 Laboratory	1022 m^2 (GNL Laboratory)

6. Scope and general description of activities, including type(s) of microorganisms and/or toxins as appropriate
The mission of the Galveston National Laboratory is to assist the National Institute of Allergy and Infectious Diseases and the nation in the development of an improved means for the prevention, diagnosis and treatment of potentially life-threatening diseases caused by naturally emerging and purposefully disseminated infectious agents. To accomplish this goal GNL conducts multidisciplinary research into the causes, modes of transmission, and mechanisms of infectious diseases. Studies focus on a number of pathogens requiring BSL-4 containment, primarily those that cause viral hemorrhagic fevers, as well as some zoonotic viruses requiring enhanced BSL-3 containment. Products likely to emerge from research and investigations within the GNL include novel diagnostic assays, improved therapeutics and treatment models, and preventative measures such as vaccines.
Additional information can be found at: http://www.utmb.edu/gnl/.

Exchange of data on research centres and laboratories

1. Name(s) of facility
The Betty Slick and Lewis J. Moorman, Jr. Laboratory Complex

2. Responsible public or private organization or company
Texas Biomedical Research Institute

3. Location and postal address
P.O. Box 760549, San Antonio, Texas 78245-0549

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence
Department of Health and Human Services (HHS)
Department of Defense (DOD) - Partly
Department of Homeland Security (DHS)
Private Sector Companies
Private Donors

5. Number of maximum containment units within the research centre and/or laboratory, with an indication of their respective size (m^2)

BSL 4 Laboratory	114 m^2

6. Scope and general description of activities, including type(s) of microorganisms and/or toxins as appropriate.
The mission of the Laboratory is to develop vaccines and therapeutics against viral pathogens, and to determine how viruses replicate and spread. Scientists are studying new and emerging disease threats, possible bioterrorism agents, and as-yet uncharacterized agents for biodefense. TXBiomed (formerly Southwest Foundation for Biomedical Research) has permits from the U.S. Department of Agriculture and the Centers for Disease Control to work on select agents. Additional information can be found at: https://www.txbiomed.org/about/extraordinary-resources/.

Exchange of data on research centres and laboratories

1. Name(s) of facility
Georgia State University - High Containment Core (HCC)

2. Responsible public or private organization or company
Georgia State University

3. Location and postal address
P.O. Box 4010, Atlanta, Georgia 30302-4118

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence
National Institutes of Health
U.S. Department of Defense - Partly
Centers for Disease Control and Prevention
Department of Health and Human Services
Georgia Research Alliance
Elizabeth R. Griffin Research Foundation

This facility resumed operation October 2019; agents (see question #6) are currently being stored in the facility. Active experimentation will not begin until July 2020. Funds listed above will be utilized at that time.

5. Number of maximum containment units within the research centre and/or laboratory, with an indication of their respective size (m^2)

BSL-4	60 m^2

6. Scope and general description of activities, including type(s) of microorganisms and/or toxins as appropriate

In 2017, the high containment facilities at Georgia State University were organized into the High Containment Core (HCC). The former National B Virus Resource Laboratory now operates as part of the core. The core is comprised of two BSL3 laboratories with animal facilities and one BSL4 Class III Cabinet Line Laboratory. Research in the BSL4 is focused on existing and emerging infectious diseases caused by BSL-4 viruses. The laboratory has not been used for experimental work since decommission in 2016. The facility was recommissioned in 2019 and was approved for storage of Tier 1 Select Agents and Toxins by the Centers for Disease Control and Prevention, Federal Select Agent Program. Experimental work with Risk Group 4 agents will commence in 2020. Below is a general description of those activities.

The proposed studies will expand our understanding of the mechanisms that regulate filovirus growth and pathogenesis. The goal is to characterize the impact of host proteins and genes on filovirus growth. We are specifically planning to perform these experiments with the filoviruses to mechanistically understand how different host factors affect virus replication, it will be necessary to measure levels of viral genomic RNA, viral mRNA and viral protein produced in cells.

Studies focused on the mechanisms by which virus kills the host and how that process can be circumvented with:

- Early identification - research focuses on the design and development of new approaches to more effectively identify these agents in both natural and foreign hosts;
- Appropriate antiviral drugs - researchers continually screen the efficacy of existing as well as novel antiviral agents to inhibit the growth of viruses that can potentially cross into the human population, either through occupational exposure or through more subtle contact; and
- In the future, effective vaccines. Additional information can be found at http://www2.gsu.edukwwwvir/Research/Index.html

Form A, Part 1 (i)

Exchange of data on research centres and laboratories

1. Name(s) of facility.

The Boston University National Emerging Infectious Diseases Laboratories (NEIDL)

2. Responsible public or private organization or company:

Boston University

3. Location and postal address.

620 Albany Street, Boston, MA 02118

4. Source(s) of financing of the reported activity, including indication if the activity is wholly or partly financed by the Ministry of Defence.

National Institute of Allergy and Infectious Disease (NIAID), U.S. National Institute of Health (NIH)
Boston University
U.S. Department of Health and Human Services (DHHS)
Pharmaceutical and Biotechnology companies
Private foundations

5. Number of maximum containment units[3] within the research centre and/or laboratory, with an indication of their respective size (m^2).

BSL-2 Laboratory	2,566 m^2
BSL-3 Laboratory	(5 suites + 8 animal rooms) 998 m^2
BSL-4 Laboratory	(All ABSL-4 spaces are integrated with 6 suites + 7 animal rooms) 1,202 m^2

Note: The changes in laboratory space from those reported in 2019 (BSL-2: 2,470 to 2,556 m^2; BSL-3: 960 to 998 m^2; BSL-4 968 to 1,202 m^2) were due to a numerical calculation error. The physical laboratory space remains unchanged.

6. Scope and general description of activities, including type(s) of microorganisms and/or toxins as appropriate.

The mission of the Boston University National Emerging Infectious Diseases Laboratories (NEIDL) is to generate and translate fundamental knowledge on high priority emerging infectious diseases for the benefit of the public health, locally, nationally, and globally. Emerging infectious diseases are defined as those that have newly appeared and been recognized in the population, or have existed but are rapidly increasing in incidence or in geographic range. To meet this mission the NEIDL will:

1. Perform innovative basic, translational, and clinical research on emerging infectious diseases, especially those identified as high priority category A, B, and C agents (http://www.niaid.nih.gov/research/emerging-infectious-diseases-pathogens), in order to develop diagnostics tests, treatments and vaccines to promote public health.
2. Provide education and training in these areas of research, in order to develop the next generation ofscientists in this field, and to support a national response in the event of a biodefense emergency.
3. Establish a research facility with the highest attention to community and laboratory safety and security.

Types of microorganisms currently being used are BSL-4 viruses. Additional information can be found at: http://www.bu.edu/today/2017/neidl-bsl-4-lab-approved/

Form A, Part 2 (i)

BWC - Confidence Building Measure

National biological defence research and development programmes - Declaration

United States of America

April 15, 2020

Form A, Part 2 (i)

National biological defence research and development programme: Declaration

Are there any national programmes to conduct biological defence research and development within the territory of the State Party, under its jurisdiction or control anywhere? Activities of such programmes would include prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxinology, physical protection, decontamination and other related research.

Yes ☒

No ☐

If the answer is Yes, complete Form A, part 2 (ii) which will provide a description of each programme

Form A, Part 2 (ii)

BWC - Confidence Building Measure

National biological defence research and development programmes - Description

United States of America

April 15, 2020

National biological defence research and development programmes: Overview

On September 18, 2018, the United States issued the National Biodefense Strategy, which contains goals and objectives that will guide the United States in assessing, preventing, detecting, preparing for, responding to, and recovering from a biological incident, whether deliberate, naturally occurring, or accidental in origin, and the accompanying Presidential Memorandum on Support for National Biodefense (NSPM-14) (see https://www.phe.gov/Preparedness/biodefense-strategy/Pages/default.aspx and https://www.whitehouse.gov/presidential-actions/presidential-memorandum-support-national-biodefense/). Integral to the strategy is a variety of research and development programs aimed at protecting against the deliberate use of biological materials to cause harm. These programs focus on the identification of harmful pathogens and outbreaks of infectious diseases, and their containment, treatment, and elimination from the environment. The programs are managed by several agencies with direct stakes in national security, environmental protection, and human and animal health and safety, including the Departments of Agriculture, Defense, Energy, Health and Human Services, Homeland Security, and the Environmental Protection Agency.

Historically, certain pathogens were selected for use as biological weapons because of their pathogenicity and other characteristics. Research on these pathogens, including study of molecular mechanisms and related diagnostic, vaccine and therapeutic development work, not only increases U.S. biodefense preparedness, but also offers inherent benefits for broader public health needs. Efforts to improve medical product stability, potency and ease-of-use that cut across disease targets could yield significant benefits for public health systems that cannot support existing treatments that require refrigeration, multiple doses or sophisticated diagnostic techniques. Similarly, biodefense initiatives to improve human and animal host defenses, to monitor emerging infectious diseases and drug-resistant microbes, and to clean up the site of a biological weapons attack benefit public health services, such as epidemiological disease surveillance and environmental remediation.

To promote the benefits gained by these programs and to ensure that the research is available to the scientific community both domestically and internationally, the United States Government encourages the publication of research funded by its biodefense programs.

For more information on U.S. Government strategies related to biodefense, including biological threat preparedness and response, please consult:

- Management of Domestic Incidents (Homeland Security Presidential Directive 5 [HSPD-5]) and the related National Response Framework;
- Presidential Policy Directive 8: National Preparedness (PPD-8);
- National Strategy for Defense of United States Agriculture and Food (HSPD-9);
- Medical Countermeasures against Weapons of Mass Destruction (HSPD-18);
- Public Health and Medical Preparedness (HSPD-21);
- Executive Order 13527 (“Establishing Federal Capabilities for the Timely Provision of Medical Countermeasures following a Biological Attack”).

National biological defence research and development programmes:

Description

1. State the objectives and funding of each programme and summarize the principal research and development activities conducted in the programme. Areas to be addressed shall include: prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxinology, physical protection, decontamination and other related research.

The Department of Defense Chemical and Biological Defense Program develops capabilities to enable the U.S. Armed Forces to deter, prevent, protect from, mitigate, respond to, and recover from the effects of chemical, biological, and radiological (CBR) threats as part of a layered, integrated defense. The Program is an integral contributor to a global and systems approach for Countering Weapons of Mass Destruction (CWMD), Global Health Security, and other pertinent mission areas.

The Program works to counter biological threats by providing complementary sets of sensors, protective equipment, and medical countermeasures to counter known and unknown threats, including novel and naturally-occurring emerging infectious diseases that may also pose a biological weapons threat. Current research focuses on host-pathogen interactions; capabilities for pre- and post-exposure therapeutics for bacterial biological select agents and novel threats; testing battlefield detection and identification methods, protective systems, and decontamination systems; the development of rapid and deployable detection assays for troop protection; and medical defenses against neurotoxins.

The Program also works on producing self-disinfecting and/or self-decontaminating materials, as well as developing, producing, and fielding capabilities for sampling, detecting, and identifying biological agents.

Biological defense related work conducted by the Department of Defense is carried out by the military services and biological defense program-focused agencies. These include funding agencies and service laboratories within the Departments of the Air Force, Army, and Navy, and the Defense Threat Reduction Agency/Joint Science and Technology Office, the Joint Program Executive Office for Chemical and Biological Defense, and the Defense Advanced Research Projects Agency.

2. State the total funding for each programme and its source.
$530,565,000 U.S. Department of Defense (DOD)

3. Are aspects of these programmes conducted under contract with industry, academic institutions, or in other non-defence facilities?
Yes

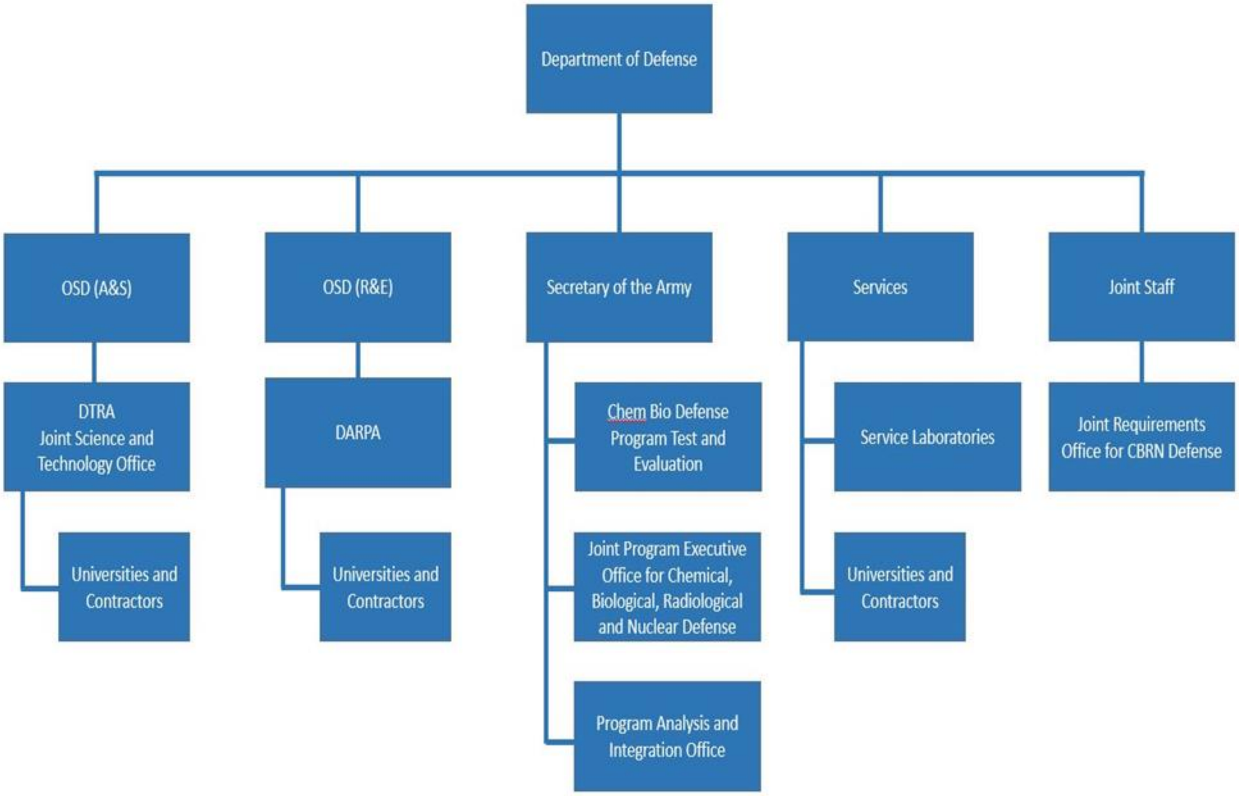
4. If yes, what proportion of the total funds for each programme is expended in these contracted or other facilities?
58.04%

5. Summarize the objectives and research areas of each programme performed by contractors and in other facilities with the funds identified under paragraph 4.

- Provide support and capabilities to protect the U.S. Armed Forces against biological warfare threats
- Development, testing, and manufacturing of vaccines, therapeutics, and diagnostic systems
- Development of self-disinfecting and/or self-decontaminating materials

- Development and testing of detection and identification methods, protective equipment, and decontamination systems

6. Provide a diagram of the organizational structure of each programme and the reporting relationships (include individual facilities participating in the programme).


Department of Defense
OSD (A&S)
OSD (R&E)
Secretary of the Army
Services
Joint Staff
DTRA Joint Science and Technology Office
DARPA
Chem Bio Defense Program Test and Evaluation
Service Laboratories
Joint Requirements Office for CBRN Defense
Universities and Contractors
Universities and Contractors
Joint Program Executive Office for Chemical, Biological, Radiological and Nuclear Defense
Universities and Contractors
Program Analysis and Integration Office

This chart reflects funding relationships

7. Provide a declaration in accordance with Form A, part 2 (iii) for each facility, both governmental and non-governmental, which has a substantial proportion of its resources devoted to each national biological defence research and development programme, within the territory of the reporting State, or under its jurisdiction or control anywhere.

- Naval Medical Research Center (NMRC) – Page 47
- Naval Research Laboratory (NRL) – Page 50
- Naval Surface Warfare Center-Dahlgren Division Chemical, Biological, Radiological (CBR) Defense Laboratory – Page 53
- Lothar Salomon Life Sciences Test Facility (LSTF) – Page 45
- U.S. Army Combat Capabilities Development Command Chemical Biological Center (CCDC CBC), formerly named U.S. Army Edgewood Chemical and Biological Center – Page 55
- U.S. Army Medical Research Institute of Chemical Defense (USAMRICD) – Page 58
- U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID) – Page 60

Neither the U.S. Army Combat Capabilities Development Command Soldier Center (CCDC SC), formerly named U.S. Army Natick Soldier Research Development and Engineering, nor the Air Force

Research Laboratory (AFRL), received funding for biodefense work in 2019 and are not included in the U.S. Confidence Building Measures covering 2019.

National biological defense research and development programmes:

Description

1. State the objectives and funding of the programme and summarize the principal research and development activities conducted in the programme. Areas to be addressed shall include: prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxicology, physical protection, decontamination and other related research.

The Environmental Protection Agency (EPA)'s mission is to protect public health and the environment. The Homeland Security Research Program (HSRP), part of the EPA's Office of Research and Development, conducts and reports on research to improve capacity to respond to and recover from environmental contamination of water infrastructure, buildings, and outdoor areas by chemical, biological, radiological and nuclear (CBRN) agents. The HSRP biodefense program focuses on EPA's two biodefense responsibilities: 1) assistance in the protection of the American water supply, and 2) decontamination of indoor and outdoor areas should the U.S. suffer a contamination incident.

EPA is designated as the government's lead sector-specific agency for water and is responsible for protecting water systems and detecting and recovering from terrorist attacks affecting them. EPA's homeland security research is responsible for developing products and providing expertise to protect, detect, respond to, and recover from terrorist attacks on the nation's water and wastewater infrastructure.

EPA is also the lead federal agency for the remediation of areas contaminated by terrorist events involving the release of biological organisms, biotoxins, chemical warfare agents, toxic industrial chemicals, and radiological materials. Terrorist acts may involve biological, chemical, and radiological agents not previously encountered as environmental pollutants. EPA's homeland security research is responsible for providing procedures and methods that will assist EPA's responders in the characterization and containment of contamination, and in the remediation of sites following terrorist attacks.

2. State the total funding for the programme and its source.
$7,600,000 U.S. Environmental Protection Agency (EPA)

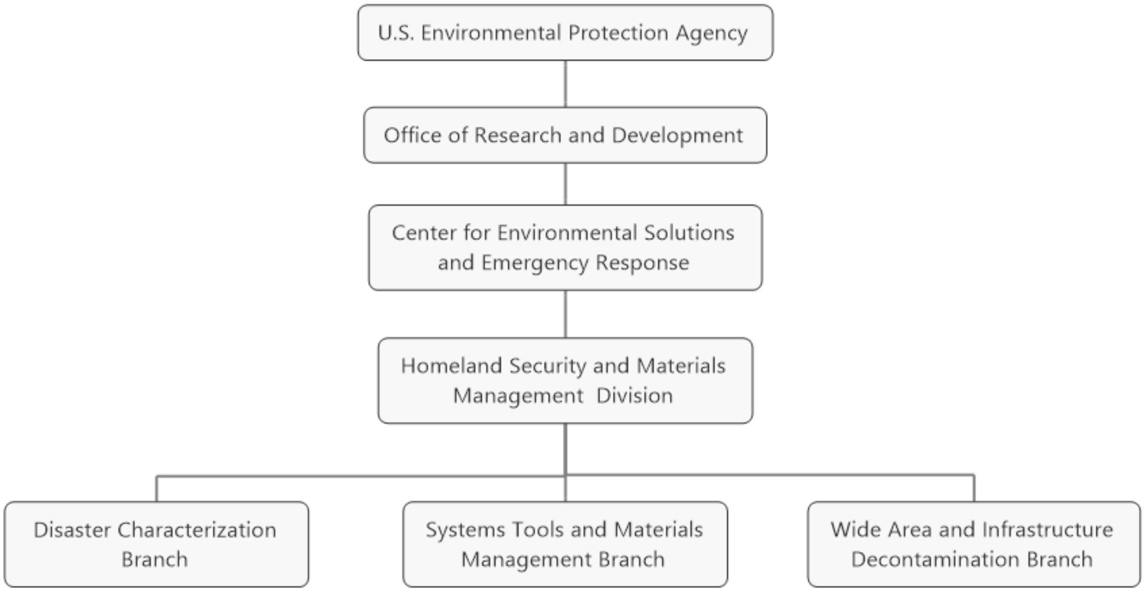
3. Are aspects of the programme conducted under contract with industry, academic institutions, or in other non-defense facilities?
Yes

4. If yes, what proportion of the total funds for the programme is expended in these contracted or other facilities?
50%

5. Summarize the objectives and research areas of the programme performed by contractors and in other facilities with the funds identified in paragraph 4.
To address capabilities related to EPA's indoor/outdoor remediation mission, HSRP, through intramural and extramural avenues, conducts research related to characterization methods, risk assessment, decontamination methods, and waste management. Specifically, the program develops and evaluates 1) sampling and analytical methods for environmental matrices, 2) decontamination methods for complex environments, and 3) treatment methods for solid and liquid waste. Supporting such capabilities, HSRP

has been addressing the fate and transport of biological agents and developing exposure assessment information and methods to support risk assessment decisions.

6. Provide a diagram of the organizational structure of the programme and the reporting relationships (include individual facilities participating in this programme.)


U.S. Environmental Protection Agency
Office of Research and Development
Center for Environmental Solutions and Emergency Response
Homeland Security and Materials Management Division
Disaster Characterization Branch
Systems Tools and Materials Management Branch
Wide Area and Infrastructure Decontamination Branch

Note: EPA's Office of Research and Development underwent organizational structural changes, effective in September 2019.

7. Provide a declaration in accordance with Form A part 2 (iii) for each facility, both governmental and non-governmental, which has a substantial proportion of its resources devoted to the national biological defense research programme, within the territory of the reporting State, or under its jurisdiction or control anywhere.

Not Applicable

National biological defence research and development programmes:

Description

1. State the objectives and funding of each programme and summarize the principal research and development activities conducted in the programme. Areas to be addressed shall include: prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxicology, physical protection, decontamination and other related research.

The Department of Health and Human Services (HHS) supports activities to improve local and state public health systems, to expand existing biosurveillance efforts, and to fund research on medical countermeasures against potential bioterror agents.

The National Institutes of Health (NIH) biodefense program is supported by funding from HHS. The NIH, and specifically the National Institute of Allergy and Infectious Diseases (NIAID), has the primary responsibility within the U.S. Government for civilian biodefense research. The intent of the program is to provide countermeasures to be used to protect the U.S. civilian population through the development of vaccines, therapeutic agents and rapid, agent-specific assays.

2. State the total funding for each programme and its source.

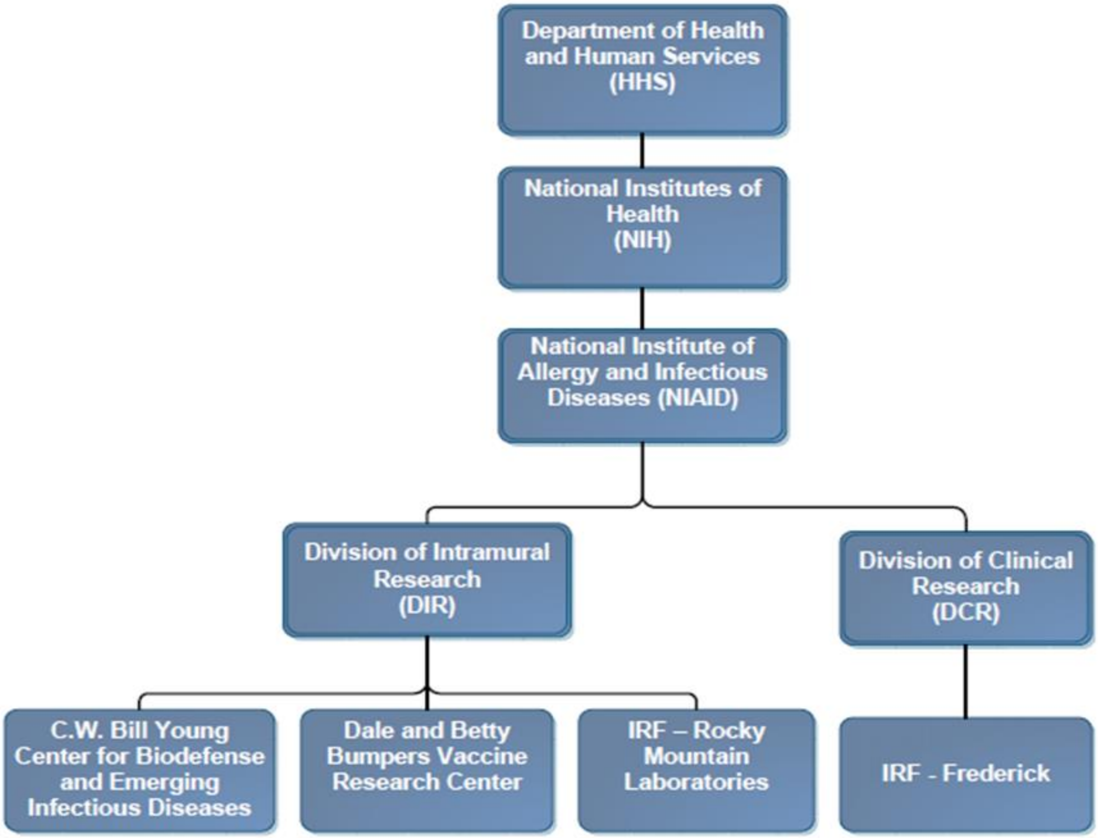
$87,671,966	Department of Health and Human Services (HHS)

3. Are aspects of these programmes conducted under contract with industry, academic institutions, or in other non-defence facilities?
Yes

4. If yes, what proportion of the total funds for each programme is expended in these contracted or other facilities?
17.5%

5. Summarize the objectives and research areas of each programme performed by contractors and in other facilities with the funds identified under paragraph 4.
Battelle Memorial Institute facilitates scientific research at the Integrated Research Facility at Fort Detrick (IRF-Frederick), including refinement of animal models to facilitate countermeasure development, with direction from the IRF Scientific Steering Committee.

6. Provide a diagram of the organizational structure of each programme and the reporting relationships (include individual facilities participating in the programme).


Department of Health and Human Services (HHS)
National Institutes of Health (NIH)
National Institute of Allergy and Infectious Diseases (NIAID)
Division of Intramural Research (DIR)
Division of Clinical Research (DCR)
C.W. Bill Young Center for Biodefense and Emerging Infectious Diseases
Dale and Betty Bumpers Vaccine Research Center
IRF – Rocky Mountain Laboratories
IRF - Frederick

7. Provide a declaration in accordance with Form A, part 2 (iii) for each facility, both governmental and non-governmental, which has a substantial proportion of its resources devoted to each national biological defence research and development programme, within the territory of the reporting State, or under its jurisdiction or control anywhere.

- Integrated Research Facility at Fort Detrick (IRF - Frederick) – Page 108
- Integrated Research Facility at Rocky Mountain Laboratories (IRF - RML) – Page 100
- C.W. Bill Young Center for Biodefense and Emerging Infectious Diseases – Page 112
- Dale and Betty Bumpers Vaccine Research Center – Page 122

Form A, Part 2 (ii)

National biological defence research and development programmes:

Description

1. State the objectives and funding of each programme and summarize the principal research and development activities conducted in the programme. Areas to be addressed shall include: prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxicology, physical protection, decontamination and other related research.

The objective of the Mass Spectrometry Toxin Laboratory and the Chemical Threats Method Development Laboratory within CDC's National Center for Environmental Health, Division of Laboratory Sciences is to develop methods for measuring selected toxins to help improve detection and diagnosis during a public health response to biological toxins.

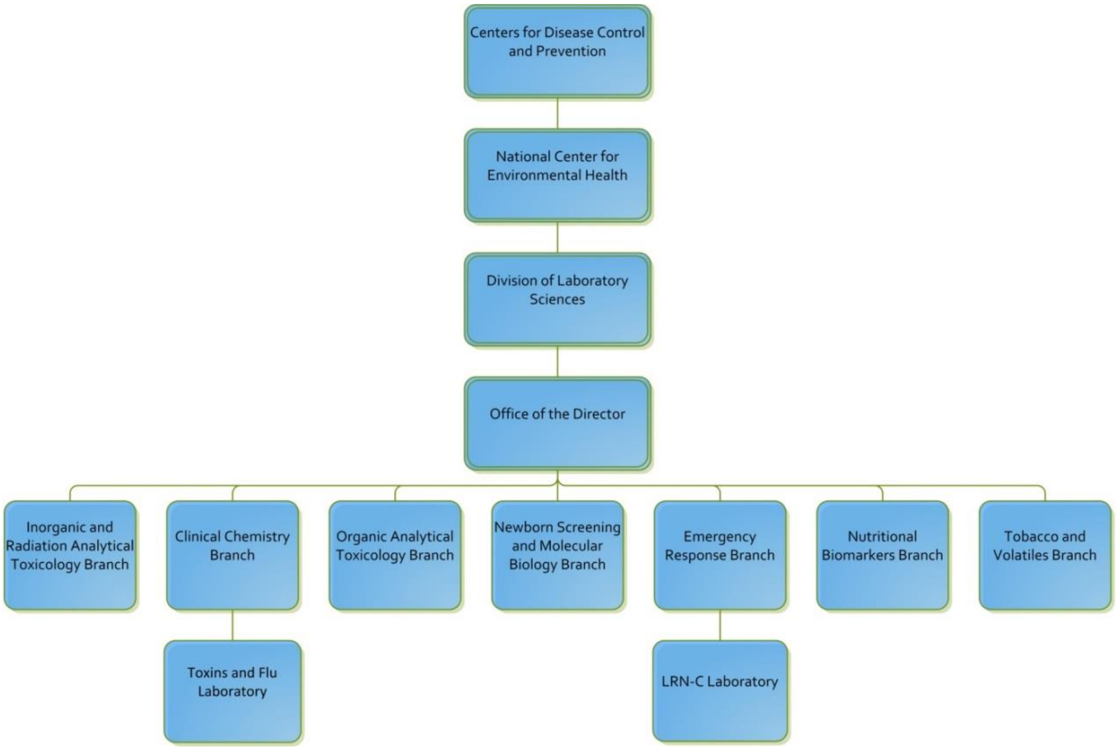
2. State the total funding for each programme and its source.
$5,248,729.78 Centers for Disease Control and Prevention (CDC)

3. Are aspects of these programmes conducted under contract with industry, academic institutions, or in other non-defence facilities?
No

4. If yes, what proportion of the total funds for each programme is expended in these contracted or other facilities?
N/A

5. Summarize the objectives and research areas of each programme performed by contractors and in other facilities with the funds identified under paragraph 4.
N/A

6. Provide a diagram of the organizational structure of each programme and the reporting relationships (include individual facilities participating in the programme).


Centers for Disease Control and Prevention
National Center for Environmental Health
Division of Laboratory Sciences
Office of the Director
Inorganic and Radiation Analytical Toxicology Branch
Clinical Chemistry Branch
Organic Analytical Toxicology Branch
Newborn Screening and Molecular Biology Branch
Emergency Response Branch
Nutritional Biomarkers Branch
Tobacco and Volatiles Branch
Toxins and Flu Laboratory
LRN-C Laboratory

7. Provide a declaration in accordance with Form A, part 2 (iii) for each facility, both governmental and non-governmental, which has a substantial proportion of its resources devoted to each national biological defence research and development programme, within the territory of the reporting State, or under its jurisdiction or control anywhere.

CDC, National Center for Environmental Health (NCEH), Division of Laboratory Sciences (DLS) – Page 87

National biological defence research and development programmes:

Description

1. **State the objectives and funding of each programme and summarize the principal research and development activities conducted in the programme. Areas to be addressed shall include: prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxinology, physical protection, decontamination and other related research.**

   The activities of the CDC Deputy Director for Infectious Disease (DDID) include developing diagnostic assays for public health, conducting molecular and antigenic characterization of microorganisms, evaluating decontamination methods, determining pathogenicity and virulence of infectious agents, determining the natural history of infectious organisms, and conducting epidemiologic studies and surveillance for diseases. Biodefense activities include those with select agents. DDID includes the National Center for Emerging Zoonotic Infectious Diseases (NCEZID) and the National Center for Immunization and Respiratory Diseases (NCIRD).

   The select agents list is available at: http://www.selectagents.gov/SelectAgentsandToxinsList.html

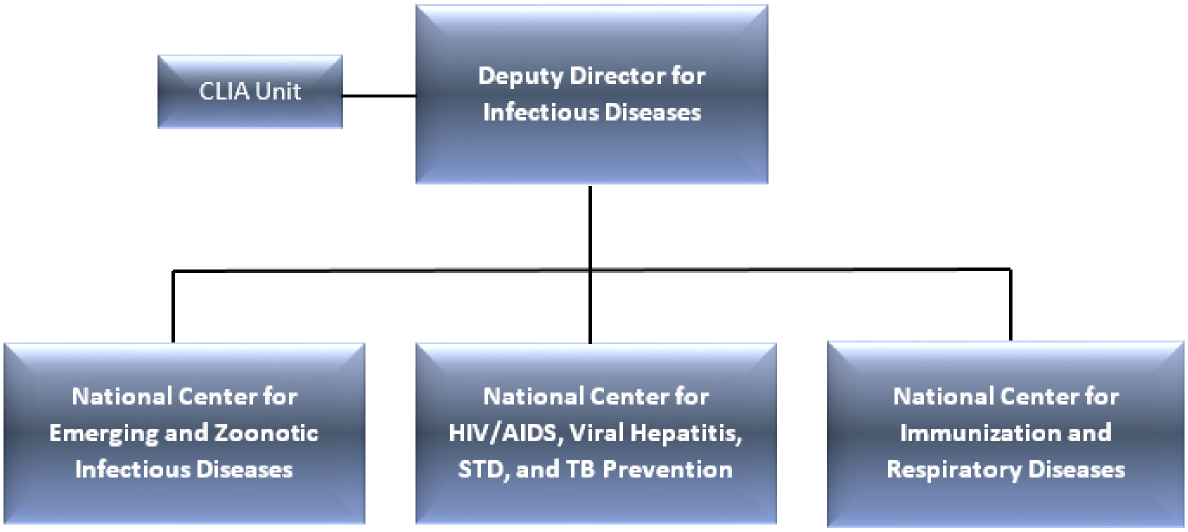
2. **State the total funding for each programme and its source.**
   $ 29,030,375 Centers for Disease Control and Prevention (CDC)

3. **Are aspects of these programmes conducted under contract with industry, academic institutions, or in other non-defence facilities?**
   Yes

4. **If yes, what proportion of the total funds for each programme is expended in these contracted or other facilities?**
   5%

5. **Summarize the objectives and research areas of each programme performed by contractors and in other facilities with the funds identified under paragraph 4.**
   Vaccine efficacy trials, reagent development, bioterrorism preparedness and response activities, avian influenza preparedness, and disease surveillance in CDC field locations.

6. **Provide a diagram of the organizational structure of each programme and the reporting relationships (include individual facilities participating in the programme).**


CLIA Unit
Deputy Director for Infectious Diseases
National Center for Emerging and Zoonotic Infectious Diseases
National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention
National Center for Immunization and Respiratory Diseases

7. **Provide a declaration in accordance with Form A, part 2 (iii) for each facility, both governmental and non-governmental, which has a substantial proportion of its resources devoted to each national biological defence research and development programme, within the territory of the reporting State, or under its jurisdiction or control anywhere.**

- CDC, Deputy Director for Infectious Diseases (DDID) – Page 89
- CDC, Deputy Director for Infectious Diseases (DDID), National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector Borne Diseases (DVBD) - Ft. Collins – Page 98

National biological defence research and development programmes:

Description

1. State the objectives and funding of the programme and summarize the principal research and development activities conducted in the programme. Areas to be addressed shall include: prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxicology, physical protection, decontamination and other related research.

Background

The U.S. Department of Agriculture's Agricultural Research Service (USDA-ARS) biodefense research program addresses foreign pathogens of plants and animals that represent a major threat to U.S. agriculture. Introduction of these agents, either accidental or deliberate, could have devastating effects on animal or plant health, and in some cases, human health. These devastating effects extend to social and economic impacts -- not only in the country's agricultural systems but also in a wide range of economic activities. Diseases of concern include but are not limited to wheat rust, Foot-and-Mouth Disease, Avian Influenza, Rift Valley Fever, Classical Swine Fever, African Swine Fever, Exotic Newcastle disease, Vesicular stomatitis, and Exotic Bluetongue.

Plant and Animal health officials define an exotic or foreign plant or animal disease as an important infectious disease of crops, livestock or poultry believed to be absent from the U.S. and its territories that has a potential significant health or economic impact. Zoonotic foreign animal diseases pose a threat to human health and animal production potentially resulting in appreciable costs due to expensive disease control and eradication efforts. To protect the long-term health and profitability of U.S. animal agriculture, incursions of a foreign animal disease must be rapidly controlled.

In the United States, control is the first step towards disease eradication. Disease eradication is currently accomplished by eliminating crops or animals, resulting in loss of foods, loss of income to the farm community, public opposition and environmental disruption. In addition to control costs, one of the most immediate and severe consequences of a foreign animal disease occurrence in the United States will be the loss of export markets. As we approach the third decade of the 21st century, many new issues and factors are affecting prevention, control, management, and recovery from foreign disease outbreaks. These factors include free trade agreements, free trade blocks, regionalization, increased international passenger travel, intensification of plant and animal production, increased climate instability, the constant evolution of infectious agents, and the uncertain impact of biotechnology and bioterrorism.

The USDA-ARS biodefense program focuses its research efforts on the prevention, detection, control, and eradication of high consequence foreign plant and animal diseases. Research efforts include furthering our understanding of pathogenesis, transmission, and host responses to emerging plant and animal diseases to enhance rapid detection and developing effective countermeasures.

Strategic Objectives

- Establish Agricultural Research Service (ARS) laboratories into a fluid, highly effective research network, to maximize the use of core competencies and resources
- Access specialized high containment research facilities to study zoonotic and emerging diseases
- Develop an integrated animal and microbial genomics research program

- Establish centers of excellence in animal immunology
- Launch a biotherapeutic discovery program providing alternatives to conventional animal drugs
- Build a technology-driven vaccine and diagnostic discovery research program
- Develop core competencies in field epidemiology and predictive biology
- Develop internationally recognized World Organisation for Animal Health (OIE) collaborative research centers
- Establish a best-in-class training center for our nation's veterinarians and scientists
- Develop a model technology transfer program to achieve the full impact of our research discoveries
- Determine basic knowledge of the biology, pathology, and epidemiology of selected plant Oomycete pathogens as the basis for development of improved control/management strategies

Research Needs

In order to control foreign animal disease, a wide variety of agent detection platforms needs to be developed and validated. Information for design of these platforms will come in part from further knowledge of pathogen genomics and proteomics and in part from understanding the evolution and genetic variability of disease agents. Although many of the foreign animal diseases have existed for many years in many countries, there is still much more fundamental knowledge of these agents that is required. There is still a lack of understanding in host range and tissue tropism, carrier state, duration and routes of shedding, transmission mechanisms, (e.g. vectors, fomites, aerosols), ecology and epidemiology (e.g., wildlife reservoirs). Lack of reagents, and the lack of stockpiling of diagnostic kits and supplies present vulnerabilities in detection and response preparedness. Effective prevention and control tools need to be developed in order to prepare for the possibility of a foreign animal disease outbreak in the United States. These could include tools for identifying suitable control strategies which take into account the short amount of time available and the cost of recovery from disease outbreaks. There is a need for development of vaccines and biotherapeutics suitable for strategic stockpiles and for integrated methods of disease control (including vector control and animal management), which lead to a better capability to regain country disease-free status and retain economic sustainability.

Expected Outputs:
- Better anticipation of introduction of foreign animal diseases (FADs)
- Capability to advise regulatory officials on scientific procedures for the prevention of introduction of FADs
- Better capability to produce effective products to control and eliminate FADs
- Real-time detection of agents in a wide range of farm matrices
- Searchable databases of genome and proteome information for major known FAD agents
- Improved ability to predict or anticipate emergence or introduction FAD agents
- Discovery of effective candidate biotherapeutics
- Discovery of effective candidate vaccines that allow differentiation of infected animals from vaccinated animals (DIVA)
- Viable integrated vector control strategies that minimize losses
- In-depth knowledge of pathogen biology, taxonomy, genetics, ecology, and pathology of emerging Oomycete pathogens that can be used to develop novel and effective exclusion, control and management strategies

The USDA-ARS biodefense research program is intramural and implemented in ARS high containment facilities in the following locations: Ames, Iowa; Orient Point, New York; Athens, Georgia; and Frederick, Maryland.

2. State the total funding for the programme and its source.

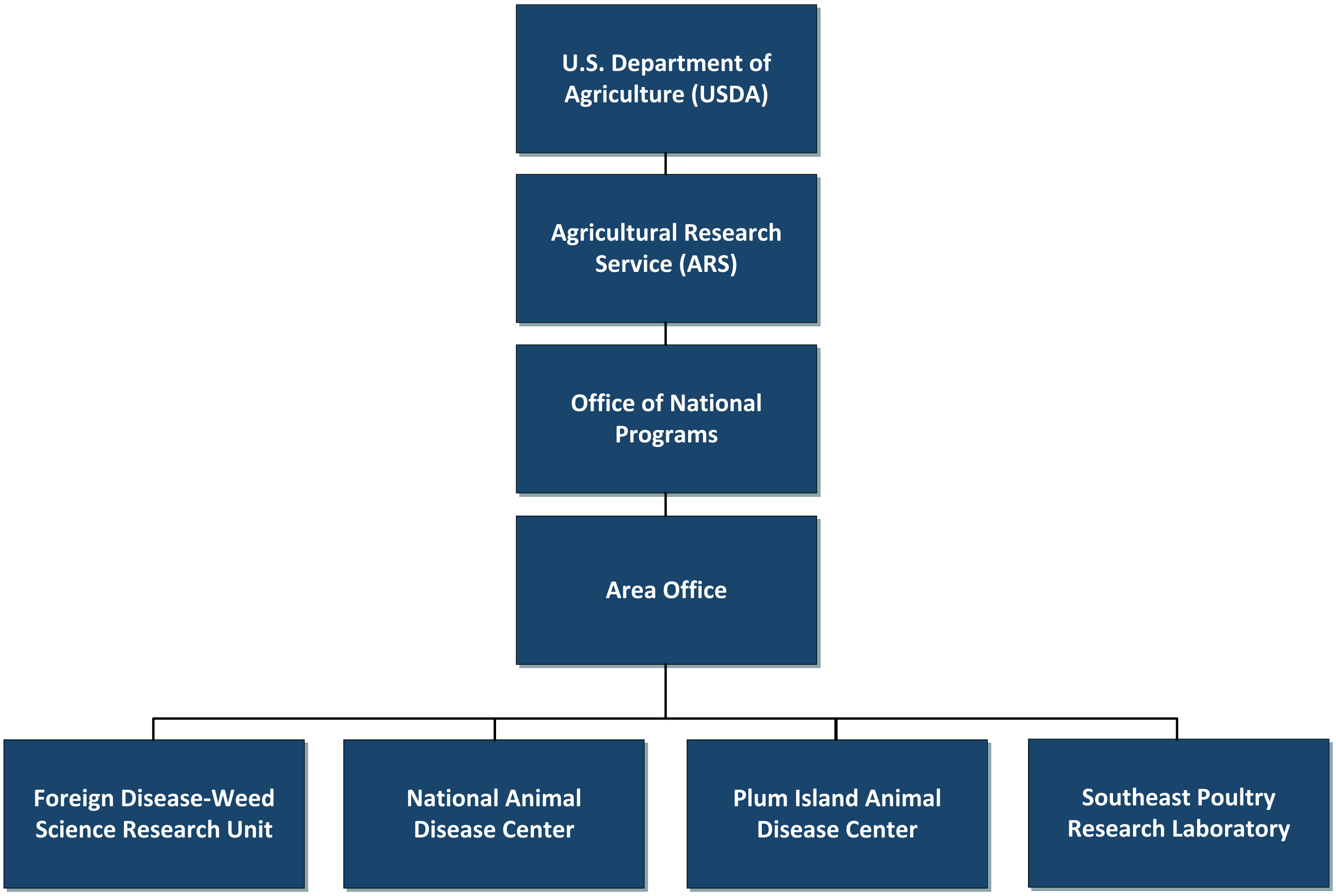
$24,000,000	U.S. Department of Agriculture (USDA)

3. Are aspects of the programme conducted under contract with industry, academic institutions, or in other non-defence facilities?
No

4. If yes, what proportion of the total funds for the programme is expended in these contracted or other facilities?
Not Applicable

5. Summarize the objectives and research areas of the programme performed by contractors and in other facilities with the funds identified in paragraph 4.
Not Applicable

6. Provide a diagram of the organizational structure of the programme and the reporting relationships (include individual facilities participating in this programme.)



U.S. Department of Agriculture (USDA)
Agricultural Research Service (ARS)
Office of National Programs
Area Office
Foreign Disease-Weed Science Research Unit
National Animal Disease Center
Plum Island Animal Disease Center
Southeast Poultry Research Laboratory

7. Provide a declaration in accordance with Form A part 2 (iii) for each facility, both governmental and non-governmental, which has a substantial proportion of its resources devoted to the national biological defence research programme, within the territory of the reporting State, or under its jurisdiction or control anywhere.

- Foreign Disease-Weed Science Research Unit – Page 124
- National Animal Disease Center (NADC) – Page 126
- Southeast Poultry Research Laboratory – Page 129
- Plum Island Animal Disease Center (PIADC) – Page 41

National biological defence research and development programmes:

Description

1. State the objectives and funding of the programme and summarize the principal research and development activities conducted in the programme. Areas to be addressed shall include: prophylaxis, studies on pathogenicity and virulence, diagnostic techniques, aerobiology, detection, treatment, toxicology, physical protection, decontamination and other related research.

Preventing terrorism and enhancing security, including protection against biological terrorism, is one of the five key Department of Homeland Security (DHS) mission areas. This includes efforts to: prevent terrorist attacks, including biological attacks; prevent the unauthorized acquisition, importation, movement, or use of, *inter alia*, biological materials and capabilities within the United States; and reduce the vulnerability of critical infrastructure to terrorist attacks and other hazards. These efforts are further guided by the National Biodefense Strategy, which outlines five goals: enable risk awareness to inform decision-making across the biodefense enterprise; ensure biodefense enterprise capabilities to prevent bioincidents; ensure biodefense enterprise preparedness to reduce the impacts of bioincidents; rapidly respond to limit the impacts of bioincidents; and facilitate recovery to restore the community, the economy, and the environment after a bioincident.

The goal of the DHS biodefense program is to protect against biological attacks targeting the U.S. population, agriculture, or infrastructure. The DHS Biodefense program focuses on scenario modelling, agent release detection, training in responding to biological events, biological countermeasures research, development, testing, and evaluation (RDT&E) efforts, and on the transition of resultant technologies to operational use. The five main areas of study are: 1) systems studies and decision support tools, 2) threat awareness, 3) surveillance and detection research and development (R&D), 4) forensics, and 5) response and restoration. The program supports other U.S. federal agencies in overall coordination of national biodefense efforts.

Efforts conducted during 2019 included comprehensive threat and risk assessments to guide prioritization of the Nation's biodefense investments, biodefense knowledge management, the development of next-generation detectors for biological threat agents for critical infrastructure and urban areas, decontamination of transit systems, and bioforensics research in support of criminal investigations and attribution. Efforts at the National Biodefense Analysis and Countermeasures Center included biological threat characterization and forensic analysis for attribution, and, at the Plum Island Animal Disease Center, development of vaccines and diagnostics for foreign animal diseases.

The DHS Compliance Review Group, chaired by the DHS Deputy Secretary, met in 2019 to review all relevant DHS-funded biological defense projects for compliance with the provisions of the Biological Weapons Convention and associated U.S. domestic laws and policies.

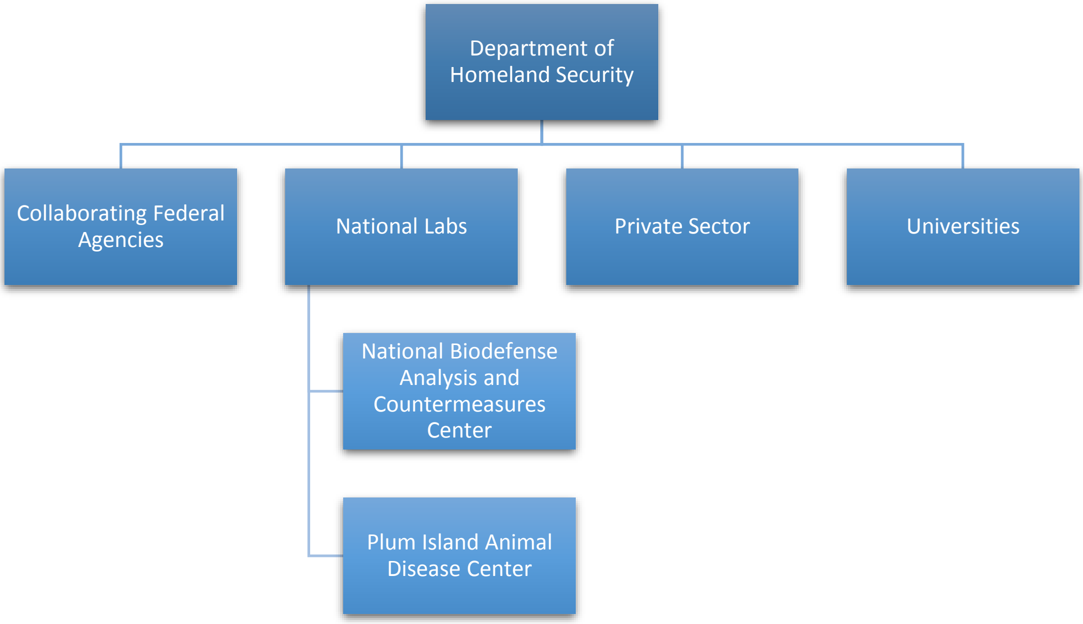
2. State the total funding for the programme and its source.
$78,421,000 U.S. Department of Homeland Security (DHS)

3. Are aspects of the programme conducted under contract with industry, academic institutions, or in other non-defence facilities?
Yes

4. If yes, what proportion of the total funds for the programme is expended in these contracted or other facilities?
100%

5. Summarize the objectives and research areas of the programme performed by contractors and in other facilities with the funds identified in paragraph 4.
Identical to answer provided in question 1.

6. Provide a diagram of the organizational structure of the programme and the reporting relationships (include individual facilities participating in this programme).


Department of Homeland Security
Collaborating Federal Agencies
National Labs
Private Sector
Universities
National Biodefense Analysis and Countermeasures Center
Plum Island Animal Disease Center

7. Provide a declaration in accordance with Form A part 2 (iii) for each facility, both governmental and non-governmental, which has a substantial proportion of its resources devoted to the national biological defence research programme, within the territory of the reporting State, or under its jurisdiction or control anywhere.

- National Biodefense Analysis and Countermeasures Center (NBACC) – Page 38
- Plum Island Animal Disease Center (PIADC) – Page 41

Form A, Part 2 (iii)

BWC - Confidence Building Measure

National biological defence research and development programmes - Facilities

United States of America

April 15, 2020

National biological defence research and development programme

For each facility detailed on Form A, Part 2 (iii), the entries given for question 3, “Floor area of laboratory areas by containment level (m^2)” represent lab space used for biodefense R&D purposes during CY19. Year-to-year variations in programming may result in variations in laboratory space reported rather than alterations to the physical laboratory space.

The U.S. Government identified potential concerns associated with public release of information regarding the presence of highly pathogenic microorganisms and toxins at specific facilities. To balance these concerns with a desire to promote transparency, rather than listing the specific microorganisms and toxins at individual facilities, the U.S. public CBM return characterizes microorganisms and toxins studied at each facility on Form A, Part 2 (iii) simply as “Select Agents” and/or “NIAID Category A pathogens.” The full lists of Select Agents and NIAID pathogens are found in Appendix A. Biological Select Agents and Toxins (Select Agents) are biological agents or toxins that have the potential to pose a severe threat to public, animal or plant health, or to animal or plant products. Possession, use and transfer of Select Agents are regulated by the Select Agent Rules. Detailed information on Select Agents and their regulation can be found at: http://www.selectagents.gov. The NIAID designated Category A pathogens as priorities for additional research efforts as part of the NIAID biodefense research agenda. Detailed information about NIAID Category A pathogens can be found at: http://www.niaid.nih.gov/topics/BiodefenseRelated/Biodefense/Pages/CatA.aspx.

The U.S. public CBM also includes an Appendix B, which is a combined list of all of the specific microorganisms and toxins studied for biodefense research and development at *all* facilities reported on Form A, part 2 (iii) below. To maintain a high level of transparency to States Parties, the United States makes available, via the restricted-access portion of the ISU website, a Supplement containing information on the microorganisms and toxins studied at each individual facility reported on Form A, part 2 (iii).

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
National Biodefense Analysis and Countermeasures Center (NBACC)

2. Where is it located (provide both address and geographical location)?
8300 Research Plaza, Fort Detrick, Maryland 21702

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	1,307 m^2
BSL-3:	2,564 m^2
BSL-4:	980 m^2
Total laboratory floor area:	4,851 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	193
(ii)	**Division of personnel:**	
	Military	0
	Civilian	193
	Division of personnel by category:	
	Scientists	40
	Engineers	43
	Technicians	62
	Administrative and support staff	48

(iii) List the scientific disciplines represented in the scientific/engineering staff:
Aerobiology, Analytical Mass Spectrometry, Bacteriology, Biochemistry, Bioinformatics, Biological Science, Biomedical Science, Biophysics, Biotechnology, Cell Biology, Chemistry, Computer Science, Genetics, Genomics, Immunology, Microbial Forensics, Microbiology, Microscopy, Molecular Biology, Toxicology, Veterinary Medicine, Virology

(iv) Are contractor staff working in the facility? If so, provide an approximate number:
Yes Number: 193

(v) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Homeland Security (DHS)
U.S. Department of Justice (DoJ)
U.S. Department of Health and Human Services (HHS)

(vi) What are the funding levels for the following program areas:

Research	$ 9,604,849
Development	$ 14,049,050
Test and evaluation	$ 0
Total	$ 23,653,899

(vii) Briefly describe the publication policy of the facility:

The NBACC publication policy is to present research results to the greater scientific community as widely as possible. As a Federally Funded Research and Development Center (FFRDC) engaged in research with select agents/regulated pathogens, NBACC has established a formal, multi-tiered review system to ensure compliance and conformance with U.S. Government laws, regulations and policies including: export control regulations under Export Administration Regulations (EAR) and International Traffic in Arms Regulations (ITAR); the Biological Weapons Convention (BWC), and internal U.S. Department of Homeland Security (DHS) policies. Prior to submittal to journals or release, all publications are reviewed by NBACC and DHS for security, clarity, and accuracy with regard to the description of the work. The DHS Management Directive for Review of External Publications can be found at https://www.dhs.gov/sites/default/files/publications/mgmt/public-affairs/mgmt-dir_md-2260-1-review-of-external-publications.pdf.

(viii) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Matthews L, Goodrich JS, Weber DJ, Bergman NH, Miller MB. Closing the Brief Case: A fatal case of necrotizing fasciitis due to multidrug-resistant Acinetobacter baumannii. J Clin Microbiol. 2019; 57(7):e01751-18. https://jcm.asm.org/content/57/7/e01754-18.long
2. Heller NC, Garrett AM, Merkley ED, Cendrowski SR, Melville AM, Arce JS, et al. Probabilistic Limit of Detection for Ricin Identification Using a Shotgun Proteomics Assay. Anal Chem. 2019; 91(19):12399−12406.https://pubs.acs.org/doi/10.1021/acs.analchem.9b02721
3. Cendrowski SR and Garrett AM. ISO 17025 Accreditation of Method-Based Mass Spectrometry for Bioforensic Analyses. ACS Symposium Series Applications in Forensic Proteomics: Protein Identification and Profiling. American Chemical Society. 2019; Vol. 1339; Chapter 10, 161-174. https://pubs.acs.org/doi/full/10.1021/bk-2019-1339.ch010
4. Schuit M, Gardner S, Wood S, Bower K, Williams G, Freeburger D, et al. The Influence of Simulated Sunlight on the Survival of Influenza virus in Aerosols. J Infect Dis. 2019; 221(3):372-378. https://www.ncbi.nlm.nih.gov/pubmed/31778532
5. Amarasinghe GK, Ayllón MA, Bào Y, Basler CF, Bavari S, Blasdell KR, et al. Taxonomy of the order Mononegavirales: update 2019. Arch Virol. 2019; 164(7):1967-1980. https://www.ncbi.nlm.nih.gov/pubmed/31089958
6. Schmidt C. Phage therapy’s latest makeover. Nat Biotechnol. 2019; 37(6):581–586. https://www.nature.com/articles/s41587-019-0133-z

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

***Objectives*:** The NBACC mission is to provide the nation with the scientific basis for characterization of biological threats and bioforensic analysis to support attribution investigations. NBACC conducts studies to fill in information gaps to better understand current and future biological threats; to assess vulnerabilities; and to determine potential impacts to guide the development of biological countermeasures such as detectors, drugs, vaccines, and decontamination technologies. When needed, NBACC conducts experimental programs to better characterize the benefits and risks of changes in U.S. biodefense preparations. NBACC also develops bioforensic assays and provides operational bioforensic analysis to support the attribution of biocrime and bioterrorism.

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[*] Including viruses and prions.

***Microorganisms and/or Toxins Studied*:** Select Agents (HHS, Overlap), Select Toxins (HHS), NIAID Category A pathogens.

***Outdoor Studies*:** No outdoor studies performed.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Plum Island Animal Disease Center (PIADC)

2. Where is it located (provide both address and geographical location)?
40550 Route 25, Orient Point, New York 11957

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	292 m^2
BSL-3:	18,046 m^2
BSL-4:	0 m^2
Total laboratory floor area:	18,338 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	461
(ii)	**Division of personnel:**	
	Military	0
	Civilian	461
(iii)	**Division of personnel by category:**	
	Scientists	88
	Engineers	4
	Technicians	18
	Administrative and support staff	351

Note: The personnel increase from 367 in 2018 to 461 in 2019 is due to the opening of a new Waste Water Treatment Facility and re-staffing following renovation efforts that ended in 2019.

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Biological Science, Chemistry, Engineering, Microbiology, Molecular Biology, Computational Biology, Pathology, Veterinary Medicine

(v) Are contractor staff working in the facility? If so, provide an approximate number:
Yes Number: 328

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Agriculture (USDA)
U.S. Department of Homeland Security (DHS)

(vii) What are the funding levels for the following program areas:

Research	\$ 7,839,954
Development	\$ 1,800,000
Test and evaluation	\$ 5,146,590
Total	\$ 14,786,544

(viii) Briefly describe the publication policy of the facility:

DHS scientific research staffs are expected to publish papers in open literature. Papers are peer reviewed and approved by PIADC and DHS for security, clarity, and accuracy with regard to the description of work prior to submittal to journals or release. All USDA Agricultural Research Service (ARS) scientists are obligated to publish scientific research data in peer-reviewed publications after review for dual use determination (not all publications by these scientists are relevant to this report). ARS scientists are encouraged to present research at scientific conferences and to publish in books and proceedings. ARS maintains a searchable online database of publications by scientists (available at https://www.ars.usda.gov/research/publications/publications-at-this-location/?modeCode=80-64-05-00). USDA Animal and Plant Health Inspection Service diagnostic staff are encouraged to publish papers in journals or other formats that are available to the public. Papers follow the review process outlined in standard operating procedure (document number SOP-NVSL-0004) titled "Approval of Manuscripts and Abstracts for Publication, and Posters and Presentations for Display."

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Arzt J, Bertram MR, Vu LT, Pauszek SJ, Hartwig EJ, Smoliga GR, et al. First Detection and Genome Sequence of Senecavirus A in Vietnam.
   Microbiol Resour Announc. 2019; 8(3):e01247-18.
   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6346150/
2. Arzt J, Fish I, Pauszek SJ, Johnson SL, Chain PS, Rai DK, et al. The evolution of a super-swarm of foot-and-mouth disease virus in cattle. PLoS ONE. 2019; 14(4):e0210847.
   https://doi.org/10.1371/journal.pone.0210847
3. Arzt J, Branan MA, Delgado AH, Yadav S, Moreno-Torres KI, Tildesley MJ, et al. Quantitative impacts of incubation phase transmission of foot-and-mouth disease virus. Sci Rep. 2019; 9(1):2707.
   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6389902/
4. Bertram MR, Dickmu S, Palinski RM, Pauszek SJ, Hartwig EJ, Smoliga GR, et al. Genome Sequences of Four Foot-and-Mouth Disease Virus SAT 1 Topotype X Isolates from Cameroon. Microbiol Resour Announc. 2019; 8(49):e01243-19.
   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6895307/
5. Bertram MR, Palinski RM, Ranjan R, Biswal JK, Pauszek SJ, Hartwig EJ, et al. Genome sequences of 18 foot-and-mouth disease virus outbreak strains of serotype O sublineage IND2001D from India, 2013 to 2014. Microbiol Resour Announc. 2019; 8(33):e00776-19.
   https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6696650/
6. Biswal JK, Ranjan R, Subramaniam S, Mohapatra JK, Patidar S, Sharma MK, et al. Genetic and antigenic variation of foot-and-mouth disease virus during persistent infection in naturally infected cattle and Asian buffalo in India. PLoS ONE. 2019; 14(6):e0214832.
   https://doi.org/10.1371/journal.pone.0214832
7. Borca MV, Holinka LG, Ramirez-Medina E, Risatti GR, Vuono EA, Berggren KA, et al. Identification of structural glycoprotein E2 domain critical to mediate replication of Classical Swine Fever Virus in SK6 cells. Virology. 2019; 526:38-44.
   https://www.sciencedirect.com/science/article/pii/S004268221830309X?via%3Dihub
8. Borca MV, Vuono EA, Ramirez-Medina E, Azzinaro P, Berggren KA, Singer M, et al. Structural Glycoprotein E2 of Classical Swine Fever Virus Interacts with Host Protein Dynactin Subunit 6 (DCTN6) during the Virus Infectious Cycle. J Virol. 2019; 94(1):e01642-19.
   https://jvi.asm.org/content/94/1/e01642-19
9. Das A, Xu L, Jia W. Development of conventional and real time PCR assays for rapid species authentication of mammalian cell lines commonly used in veterinary diagnostic laboratories. Res Vet Sci. 2019; 126:170-177.
   https://www.sciencedirect.com/science/article/abs/pii/S0034528819303807?via%3Dihub

10. Fernandez-Sainz I, Gavitt TD, Koster M, Ramirez-Medina E, Rodriguez YY, Wu P, et al. The VP1 G-H loop hypervariable epitope contributes to protective immunity against Foot and Mouth Disease Virus in swine. Vaccine. 2019; 37(26):3435-3442. https://doi.org/10.1016/j.vaccine.2019.05.019
11. Fish IH, Vierra D, Ehizibolo DO, Palinski R, Bertram MR, Pauszek SJ, et al. Near-full-length genome sequence of a foot-and-mouth disease virus of serotype southern African territories 2 isolated from Nigeria in 2014. Microbiol Resour Announc. 2019; 8(35):e00788-19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6715872/
12. Laughlin RC, Madera R, Peres Y, Berquist BR, Wang L, Buist S, et al. Plant-made E2 glycoprotein single-dose vaccine protects pigs against classical swine fever. Plant Biotechnol J. 2019; 17(2):410-420. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6335066/
13. Martel E, Forzono E, Kurker R, Clark BA, Neilan JG, Puckette M. Effect of foot-and-mouth disease virus 3C protease B2 beta-Strand proline mutagenesis on expression and processing of the P1polypeptide using a plasmid expression vector. J Gen Virol. 2019; 100(3):446-456. https://www.microbiologyresearch.org/content/journal/jgv/10.1099/jgv.0.001204#tab2
14. Munsey A, Mwiine FN, Ochwo S, Velazquez-Salinas L, Ahmed Z, Maree F, et al. Spatial distribution and risk factors for foot and mouth disease virus in Uganda: Opportunities for strategic surveillance. Prev Vet Med. 2019; 171(1):104766. https://doi.org/10.1016/j.prevetmed.2019.104766
15. Mwiine FN, Velazquez-Salinas L, Ahmed Z, Ochwo S, Munsey A, Kenney M, et al. Serological and phylogenetic characterization of foot and mouth disease viruses from Uganda during cross-sectional surveillance study in cattle between 2014 and 2017. Transbound Emerg Dis. 2019; 66(5):2011-2024. https://onlinelibrary.wiley.com/doi/abs/10.1111/tbed.13249
16. O'Donnell VK, Grau FR, Mayr GA, Sturgill Samayoa TL, Dodd KA, Barrette RW. Rapid sequence-based characterization of African swine fever virus using the Oxford Nanopore MinION sequence sensing device and a companion analysis software tool. J Clin Microbiol. 2019; 58(1):e01104-19. https://jcm.asm.org/content/58/1/e01104-19.long
17. Omondi G, Alkhamis MA, Obanda V, Gakuya F, Sangula A, Pauszek S, et al. Phylogeographical and cross-species transmission dynamics of SAT1 and SAT2 foot-and-mouth disease virus in Eastern Africa. Mol Ecol. 2019; 28(11):2903-2916. https://doi.org/10.1111/mec.15125
18. Palinski RM, Sangula A, Gakuya F, Bertram MR, Pauszek SJ, Hartwig EJ, et al. Foot-and-mouth disease virus serotype a genome sequence from Kenya in 2016. Microbiol Resour Announc. 2019; 8(38):e00987-19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6753279/
19. Palinski RM, Sangula A, Gakuya, Bertram MR, Pauszek SJ, Hartwig EJ, et al. Genome sequences of foot-and-mouth disease virus SAT1 and SAT2 strains from Kenya in 2014 to 2016. Microbiol Resour Announc. 2019; 8(36):e00809-19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6728644/
20. Palinski RM, Bertram MR, Vu LT, Pauszek SJ, Hartwig EJ, Smoliga GR, et al. First genome sequence of foot-and-mouth disease virus serotype O sublineage IND2001E from southern Vietnam. Microbiol Resour Announc. 2019; 8(10):e01424-18. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6406109/
21. Palinski RM, Sangula A, Gakuya F, Bertram MR, Pauszek SJ, Hartwig EJ, et al. First report of near-complete genome sequences o foot-and-mouth disease virus serotype O strains from Kenya. Microbiol Resour Announc. 2019; 8(35):e00808-19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6715873/
22. Ramirez-Medina E, Vuono E, O'Donnell V, Holinka LG, Silva E, Rai A, et al. Differential effect of the deletion of African Swine Fever virus virulence-associated genes in the induction of attenuation of the highly virulent Georgia strain. Viruses. 2019; 11(7):e599. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6669436/
23. Sitt T, Kenney M, Barrera J, Pandya M, Eckstrom K, Warner M, et al. Duration of protection and humoral immunity induced by an adenovirus-vectored subunit vaccine for foot-and-mouth disease (FMD) in Holstein steers. Vaccine. 2019; 37(42):6221-6231. https://doi.org/10.1016/j.vaccine.2019.08.017

24. Stenfeldt C, Pacheco JM, Singanallur NB, Vosloo W, Rodriguez LL, Arzt J. Virulence beneath the fleece; a tale of foot-and-mouth disease virus pathogenesis in sheep. PLoS ONE. 2019; 14(12):e0227061. https://doi.org/10.1371/journal.pone.0227061
25. Velazquez-Salinas L, Pauszek SJ, Barrera J, Clark BA, Borca MV, Verdugo-Rodriguez A, et al. Validation of a site-specific recombination cloning technique for the rapid development of a full-length cDNA clone of a virulent field strain of vesicular stomatitis New Jersey virus. J Virol Methods. 2019; 265:113-116. https://doi.org/10.1016/j.jviromet.2019.01.003
26. Velazquez-Salinas L, Pauszek SJ, Rodriguez LL. Complete genome sequence of a representative New Jersey vesiculovirus strain, NJ03CpB, from a region of endemicity in southern Mexico. Microbiol Resour Announc. 2019; 8(25):e00499-19. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6588370/
27. Velazquez-Salinas L, Verdugo-Rodriguez A, Rodriguez LL, Borca MV. The role of interleukin 6 during viral infections. Front Microbiol. 2019; 10:1057. https://www.frontiersin.org/articles/10.3389/fmicb.2019.01057/full
28. Visser LJ, Medina GN, Rabouw HH, de Groot RJ, Langereis MA, de Los Santos T, et al. Foot-and-Mouth Disease Virus Leader Protease Cleaves G3BP1 and G3BP2 and Inhibits Stress Granule Formation. J Virol. 2019; 93(2):e00922-18. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6321903/
29. Vuono EA, Ramirez-Medina E, Holinka LG, Baker-Branstetter R, Borca MV, Gladue DP. Interaction of structural glycoprotein E2 of classical swine fever virus with protein phosphatase 1 catalytic subunit beta (PPP1CB). Viruses. 2019; 11(4):E307. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6521620/
30. Wang Y, Das A, Zheng W, Porter E, Xu L, Noll L, et al. Development and evaluation of multiplex real-time RT-PCR assays for the detection and differentiation of foot-and-mouth disease virus and Seneca Valley virus 1. Transbound Emerg Dis. 2019; 00:1-13. doi:10.1111/tbed.13373. https://onlinelibrary.wiley.com/doi/abs/10.1111/tbed.13373
31. Yadav S, Stenfeldt C, Branan MA, Moreno-Torres KI, Holmstrom LK, Delgado AH, et al. Parameterization of the Durations of Phases of Foot-And-Mouth Disease in Cattle. Front Vet Sci. 2019; 6:263. https://www.frontiersin.org/articles/10.3389/fvets.2019.00263/full
32. Zhu JJ, Canter JA, Rodriguez LL, Arzt J. A novel bovine CXCL15 gene in the GRO chemokine gene cluster. Vet Immunol Immunopathol. 2019; 220:109990. https://doi.org/10.1016/j.vetimm.2019.109990
33. Zhu JJ, Ramanathan P, Bishop EA, O'Donnell V, Gladue DP, Borca MV. Mechanisms of African swine fever virus pathogenesis and immune evasion inferred from gene expression changes in infected swine macrophages. PLoS One. 2019; 14(11):e0223955. https://doi.org/10.1371/journal.pone.0223955

5. **Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols**:

Objectives: PIADC provides the only research and development and confirmatory diagnostic capability for specific high-consequence, contagious, foreign animal diseases of livestock, including foot-and-mouth disease in the United States. Technologies researched and developed are vaccines, antivirals, and diagnostic methods.

Microorganisms and/or Toxins Studied: Select Agents (USDA)

Outdoor Studies: No outdoor studies performed

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Lothar Salomon Test Facility (LSTF)

2. Where is it located (provide both address and geographical location)?
2029 Burns Road, TEDT-DPW-LS MS#6, Dugway, Utah 84022-5006

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	1,111 m^2
BSL-3:	1,174 m^2
BSL-4:	0 m^2
Total laboratory floor area:	2,285 m^2

Note: The increases in laboratory floor area are due to the inclusion of a recently constructed annex that was added to the existing lab structure.

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	37
(ii)	**Division of personnel:**	
	Military	0
	Civilian	37
(iii)	**Division of personnel by category:**	
	Scientists	20
	Engineers	0
	Technicians	8
	Administrative and support staff	9

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Aerobiology, Bacteriology, Biochemistry, Immunology, Microbiology, Molecular Biology, Toxicology, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number:
Yes. Number: 9

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Defense (DoD) – Wholly

(vii) What are the funding levels for the following program areas:

Research	$ 0
Development	$ 0
Test and evaluation	$ 843,008
Total	$ 843,008

(viii) Briefly describe the publication policy of the facility:
It is Army policy to encourage scientific and technical personnel to publish research procedures and results in recognized professional journals as well as present their work at national and international professional meetings. Such publication is an important part of the Army's research and development program.

Publications are prepared and published in accordance with Army regulations. The regulations governing the publication of research findings include:
AR 70-31 "Standards for Technical Reporting"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN4633_AR70-31_WEB_Final.pdf
AR 360-1 "The Army Public Affairs Program"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN6644_AR360-1_Admin_WEB_FINAL.pdf
AR 530-1 "Operations Security"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/r530_1.pdf

Professional scientists are encouraged to publish papers in peer reviewed journals. All publications must obtain the necessary command and public affairs permission before submission. Release of DoD publications is guided by DoD Directive 5230.09, Clearance of DoD Information for Public Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf) and DoD Instruction 5320.29, Security and Policy Review of DoD Information for Public Release (http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf).

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

None

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

Objectives: Testing battlefield detection and identification methods, protective equipment, and decontamination systems, including interferent testing of biological detectors and to develop/validate aerosol particle dispersion models to enhance countermeasure response. https://www.dugway.army.mil/LifeSciences.aspx.

Microorganisms and/or Toxins Studied: None

Outdoor Studies: None

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Naval Medical Research Center (NMRC)

2. Where is it located (provide both address and geographical location)?
8400 Research Plaza, Fort Detrick, Maryland 21702

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	2,000 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	2,000 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	87
(ii)	**Division of personnel:**	
	Military	19
	Civilian	68
(iii)	**Division of personnel by category:**	
	Scientists	14
	Engineers	0
	Technicians	65
	Administrative and support staff	8

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Biochemistry, Computational Biology, Immunology, Microbiology, Molecular Biology

(v) Are contractor staff working in the facility? If so, provide an approximate number:
Yes Number: 57

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Defense – Wholly

(vii) What are the funding levels for the following program areas:

Research	$ 20,704,000
Development	$ 0
Test and evaluation	$ 0
Total	$ 20,704,000

(viii) Briefly describe the publication policy of the facility:
Professional scientists are encouraged to publish worthy papers in peer reviewed journals. All publications must obtain the necessary command and public affairs clearance before submission. Release of DoD publications is guided by DoD Directive 5230.09, Clearance of DoD Information for Public

Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523009p_1.pdf?ver=2019-06-26-120334-963) and DoD Instruction 5320.29, Security and Policy Review of DoD Information for Public Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf)

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Voegtly LJ, Rice GK, Cer RZ, Frey KG, Biswas B, Hamilton T, Aslam S, Bishop-Lilly KA. High quality draft genome sequence of Pseudomonas aeruginosa 268 isolated from a patient with left ventricular assist device. Microbiol Resource Announc. 2019 Jan 3;8(1). https://www.ncbi.nlm.nih.gov/pubmed/30637391
2. Millar EV, Rice GK, Schlett CD, Elassal EM, Cer RZ, Frey KG, Hamilton TC, Ellis MW, Tribble DR, Bishop-Lilly KA, Bennett JW. Genomic epidemiology of MRSA infection and colonization isolates among military trainees with skin and soft tissue infection. Infection. 2019 Oct;47(5):729-737. Epub 2019 Feb 22. https://www.ncbi.nlm.nih.gov/pubmed/30796628
3. Paskey AC, Frey KG, Schroth G, Gross S, Hamilton T, Bishop-Lilly KA. Enrichment Post-Library Preparation Enhances the Sensitivity of High-Throughput Sequencing-Based Detection and Characterization of Viruses from Complex Samples. BMC Genomics. 2019 Feb 26;20(1):155. doi: 10.1186/s12864-019-5543-2. https://www.ncbi.nlm.nih.gov/pubmed/30808306
4. Schully KL, Bell MG, Spall A, Yu K, Burtnick M, Mayo M, Theobald V, Clark DV, Maves RC, Currie BJ, Brett PJ, Lawler JV. Serological evidence of Burkholderia pseudomallei infection in US Marines who trained in Australia from 2012-2014: a retrospective analysis of archived specimens. MSMR. 2019 Jul; 26(7):8-17. https://www.ncbi.nlm.nih.gov/pubmed/31347371
5. Aslam S, Courtwright AM, Koval C, Lehman SM, Morales S, Furr CL, Rosas F, Brownstein MJ, Fackler JR, Sisson BM, Biswas B, Henry M, Luu T, Bivens BN, Hamilton T, Duplessis C, Logan C, Law N, Yung G, Turowski J, Anesi J, Strathdee SA, Schooley RT. Early clinical experience of bacteriophage therapy in 3 lung transplant recipients. Am J Transplant. 2019 Sep; 19(9):2631-2639. Epub 2019 Jul 17. https://www.ncbi.nlm.nih.gov/pubmed/31207123
6. Krishnan S, Beckett C, Espinosa B, Clark DV. Austere environments Consortium for Enhanced Sepsis Outcomes (ACESO). Shock. 2019 Sep 17. Epub ahead of print. https://www.ncbi.nlm.nih.gov/pubmed/31568224
7. Berry IM, Melendrez MC, Bishop-Lilly KA, Rutvisuttinunt W, Pollett S, Talundzic E, Morton L, Jarman RG. Next generation sequencing and bioinformatics methodologies for infectious disease research and Public Health: Approaches, applications, and considerations for development of laboratory capacity. J Infect Dis. 2019 Oct 14. Epub ahead of print. https://www.ncbi.nlm.nih.gov/pubmed/31612214
8. Ko E, Philipson C, Burke TW, Cer RZ, Bishop-Lilly KA, Voegtly L, Tsalik EL, Woods CW, Clark D, Schully KL. Direct-from-blood RNA sequencing identifies the cause of fatal post-bronchosscopy fever. BMC Infect Dis. 2019 Oct 28; 19(1):905. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6819639/
9. Ecale Zhou CL, Maltatti S, Kimbrel J, Philipson C, McNair K, Hamilton T, Edwards R, Souza B. multiPhATE: bioinformatics pipeline for functional annotation of phage isolates. Bioinformatics. 2019 Nov 1;35(21):4402-4404. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6821344/
10. Nir-Paz R, Gelman D, Khouri A, Sisson B, Fackler J, Alkalai-Oren S, Khalifa L, Rimon A, Yeruchalmy O, Bader R, Amit S, Coppenhagen-Glazer S, Henry M, Quinones J, Malagon F, Biswas B, Moses AI, Merril G, Schooley RT, Brownstein MJ, Weil YA, Hazan R. Successful treatment of antibiotic resistant poly-microbial bone infection with bacteriophages. Clin Infect Dis. 2019 Nov 13;69(11):2015-2018. https://www.ncbi.nlm.nih.gov/pubmed/30869755

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

Objectives: The goal of the program is the development of rapid and deployable detection assays to protect deployed troops. During 2019, we continued studying clinical cases of sepsis in austere environments with the ultimate goal of understanding host-pathogen interactions, development of new diagnostic assays and better treatment strategies against relevant infectious diseases. Additional efforts include: development of a diagnostic for Bacillus anthracis using phage combined with other technology, a program to improve over traditional diagnostics for Rickettsia prowazekii, and a program aimed at developing and testing a virus enrichment sequencing assay for viruses of biosurveillance and biodefense concern. Additional information is available at https://www.med.navy.mil/sites/nmrc/NMRC/Pages/NMRC.aspx

Microorganisms and/or Toxins Studied: Select Agents (HHS, Overlap) and HHS Select Toxins, NIAID Category A pathogens

Outdoor Studies: None

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Naval Research Laboratory (NRL)

2. Where is it located (provide both address and geographical location)?
4555 Overlook Ave., SW, Washington, D.C. 20375

3. Floor area of laboratory areas by containment level (m^2):

BSL-1:	358 m^2
BSL-2:	394 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	752 m^2

Note: The changes in NRL laboratory space from 2018 are due to shifting research and development activities. The laboratory areas were not physically remodeled.

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	31
(ii)	**Division of personnel:**	
	Military	1
	Civilian	30
(iii)	**Division of personnel by category:**	
	Scientists	25
	Engineers	2
	Technicians	4
	Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Biochemistry, Biophysics, Chemical Engineering, Chemistry, Electrical Engineering, Engineering, Immunology, Mechanical Engineering, Microbiology, Molecular Biology, Physics

(v) Are contractor staff working in the facility? If so, provide an approximate number:
Yes Number: 5

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Defense – Wholly

(vii) What are the funding levels for the following program areas:

Research	$ 2,400,000
Development	$ 3,800,000
Test and evaluation	$ 500,000
Total	$ 6,700,000

(viii) Briefly describe the publication policy of the facility:

Professional scientists are encouraged to publish papers in peer reviewed journals. All publications must obtain the necessary command and public affairs permission before submission. Release of DoD publications is guided by DoD Directive 5230.09 (Clearance of DoD Information for Public Release, https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf) and DoD Instruction 5320.29 (Security and Policy Review of DoD Information for Public Release, https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523009p_1.pdf?ver=2019-06-26-120334-963) for publishing information related to biological defense efforts. Public release of unclassified technical information is subject to sponsor approval.

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Anderson, G.P., Liu, J.L., Shriver-Lake, L.C., Zabetakis, D., Sugiharto, V.A., Chen, H.-W., Lee, C.-R., Defang, G.N., Wu, S.-J.L., Venkateswaran, N., Goldman, E.R. Oriented Immobilization of Single-Domain Antibodies Using SpyTag/SpyCatcher Yields Improved Limits of Detection. Analytical Chemistry. 2019; 91 (15), pp. 9424-9429. doi: 10.1021/acs.analchem.9b02096. https://pubs.acs.org/doi/10.1021/acs.analchem.9b02096
2. Hu X, Compton, J.R., Legler, P.M. 2019. Analysis of Group IV viral SSHHPS Using In vitro and In silico Methods. JOVE In Press. 2019; https://www.ncbi.nlm.nih.gov/pubmed/31904018
3. Liu, J.L., Shriver-Lake, L.C., Zabetakis, D., Anderson, G.P., Goldman, E.R. Selection and characterization of protective anti-chikungunya virus single domain antibodies Molecular Immunology. 2019; 105, pp. 190-197. doi: 10.1016/j.molimm.2018.11.016 https://www.sciencedirect.com/science/article/pii/S0161589018306710?via%3Dihub
4. Lu, Q.; E. Barlow, D. E.; Haridas, D.; Giordano, B. C.; Ladouceur, H. D.; Gaston, J. D; Collins, G. E.; Terray, A. V. Flow-Through Optical Chromatography in Combination with Confocal Raman Microspectroscopy: A Novel Label-Free Approach To Detect Responses of Live Macrophages to Environmental Stimuli. ACS Omega. 2019; 4, 12938−12947 (18-1231-3702) https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6682052/
5. Morazzani EM, Compton JR, Leary DH, Berry AV, Hu X, Marugan J, Glass PJ, Legler PM. Proteolytic cleavage of host proteins by the Group IV viral proteases of Venezuelan equine encephalitis virus and Zika virus. Antiviral Research. 2019; 164:106-122. https://www.ncbi.nlm.nih.gov/pubmed/30742841
6. Olson MA, Legler PM, Zabetakis D, Turner KB, Anderson GP, Goldman ER. Sequence Tolerance of a Single-Domain Antibody with a High Thermal Stability: Comparison of Computational and Experimental Fitness Profiles. ACS Omega. 2019; 4:10444-10454. https://pubs.acs.org/doi/pdf/10.1021/acsomega.9b00730
7. Zabetakis, D., Shriver-Lake, L.C., Olson, M.A., Goldman, E.R., Anderson, G.P. Experimental evaluation of single-domain antibodies predicted by molecular dynamics simulations to have elevated thermal stability. Protein Science. 2019; 28:1909–1912. doi: 10.1002/pro.3692. https://onlinelibrary.wiley.com/doi/abs/10.1002/pro.3692

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

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[*] Including viruses and prions.

Objectives: The objectives of research at NRL are to develop and test reliable systems for the detection of chemical and biological (CB) warfare agents in order to provide early warning and contamination avoidance information. Additional information is available at http://www.nrl.navy.mil/research/

Microorganisms and/or Toxins Studied: Simulants of Select Agents (HHS, Overlap) and Toxins, NIAID Category A pathogens.

Outdoor Studies: None

Form A, Part 2 (iii)

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Naval Surface Warfare Center-Dahlgren Division, Chemical, Biological, Radiological (CBR) Defense Laboratory

2. Where is it located (provide both address and geographical location)?
6149 Welsh Road, Dahlgren, Virginia 22448

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	180 m^2
BSL-3:	27 m^2
BSL-4:	0 m^2
Total laboratory floor area:	207 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	76

(ii) **Division of personnel:**

Military	0
Civilian	76

(iii) **Division of personnel by category:**

Scientists	39
Engineers	17
Technicians	13
Administrative and support staff	7

(iv) **List the scientific disciplines represented in the scientific/engineering staff:**
Aerospace Engineering, Chemical Engineering, Chemistry, Computer Engineering, Computer Science, Electronic Engineering, Industrial Engineering, Mathematics, Mechanical Engineering, Microbiology, Molecular Biology, Operations Research Analysis, Physics, Toxicology

(v) **Are contractor staff working in the facility? If so, provide an approximate number:**
Yes Number: 2

(vi) **What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?**
U.S. Department of Defense (DoD) – Partly
Private Sector Companies
Internal (Laboratory Directed Research and Development [LDRD])
Other Governmental Agencies

(vii) **What are the funding levels for the following program areas:**

Research	$ 1,902,265
Development	$ 4,225,959
Test and evaluation	$ 159,794
Total	$ 6,288,018

(viii) Briefly describe the publication policy of the facility:
Employees are encouraged to publish. Employees must follow appropriate U.S. DoD guidelines for publishing information related to biological defense efforts and have all publications approved. Public release of unclassified technical information is subject to sponsor approval.

Release of DoD publications is guided by DoD Directive 5230.09, Clearance of DoD Information for Public Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf) and DoD Instruction 5320.29, Security and Policy Review of DoD Information for Public Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523009p_1.pdf?ver=2019-06-26-120334-963)

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Standard Practice for Microbial Preservation. ASTM E35.15 Work Item 63006. 2019. https://www.astm.org/DATABASE.CART/WORKITEMS/WK63006.htm
2. Tony L. Buhr, Neil Kennihan, Zachary A. Minter, Alice Young, Erica Borgers-Klonkowski, Emily Osborn, Matt Bohmke, Shelia Hamilton, Monique Kimani, Andrea Staab, Mark Hammon, Charles Miller, Ryan Mackie, Sam Lilly. Combining Spore Germination and Heat Inactivation to Decontaminate Materials Contaminated with Bacillus anthracis Spores. Accepted by J Appl Microbiol. 2019; https://www.ncbi.nlm.nih.gov/pubmed/31573710
3. Cote, C., Buhr, T., Bernhards, C.B., Bohmke, M.D., Calm, A.M., Esteban-Trexler, J.S., Hunter, M., Katoski, S.E., Kennihan, N., Klimko, C.P., Miller, J.A., Minter, Z.A, Pfarr, J.W., Prugh, A.M., Quirk, A.V., Rivers, B.A., Shea, A.A., Shoe, J.L., Sickler, T.M., Young, A.A., Fetterer, D.P., Welkos, S.L., Bozue, J.A., McPherson, D., Fountain, A.W. III, and Gibbons, H.S. A Standard Method to Inactivate Bacillus anthracis Spores to Sterility via Gamma Irradiation. Appl Environ Microbiol. 2018. 84:e00106-18. https://www.ncbi.nlm.nih.gov/m/pubmed/29654186/

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

Objectives: Efforts at this defense laboratory are focused on biological detection systems, collective and individual protection systems, hazard mitigation technologies, risk assessment tools and consequence management planning.

Microorganisms and/or Toxins Studied: Overlap Select Agent + NIAID Category A, and simulants

Outdoor Studies: Performance testing of a prototype biosurveillance system using a biological simulant.

Note: The NSWC Dahlgren Chemical and Biological Defense Division in large part was moved to NSWC Indian Head over the past year. The only remaining portion of the division at NSWC Dahlgren is the technical, laboratory-focused aspect. All of the collective protection programs and support programs were moved to Indian Head. Therefore, a significant number of programs, personnel and funding were terminated, or re-allocated during the year. This accounts for the decrease in personnel, specifically non-technical personnel, as well as the decrease in funding for the division.

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?

U.S. Army Combat Capabilities Development Command Chemical and Biological Center (CCDC CBC), formerly named U.S. Army Edgewood Chemical and Biological Center (ECBC).

2. Where is it located (provide both address and geographical location)?

5183 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010-5424

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	403 m2
BSL-3:	177 m2
BSL-4:	0 m2
Total laboratory floor area:	580 m2

Note: The BSL-2 laboratory space used for biodefense research and development was decreased from 532 to 403 m^2. The BSL-2 laboratory space was not physically remodeled.

4. The organizational structure of each facility:

(i)	**Total number of personnel**	75
(ii)	**Division of personnel:**	
	Military	0
	Civilian	75
(iii)	**Division of personnel by category:**	
	Scientists	54
	Engineers	3
	Technicians	18
	Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff.

Aerobiology, Aerospace Engineering, Biochemistry, Biomedical Engineering, Biotechnology, Chemical Engineering, Chemistry, Computer Engineering, Immunology, Mathematics, Mechanical Engineering, Microbiology, Molecular Biology, Operations Research Analysis, Physics, Physiology, Toxicology, Toxinology, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number.

Yes Number: 5

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?

U.S. Department of Defense (DoD) – Wholly

(vii) What are the funding levels for the following programme areas:

Research	$15,797,000
Development	$ 6,108,000
Test and evaluation	$ 0

Total $21,905,000

(viii) Briefly describe the publication policy of the facility:

It is Army policy to encourage scientific and technical personnel to publish research procedures and results in recognized professional journals as well as present their work at national and international professional meetings. Such publication is an important part of the Army's research and development program.

Publications are prepared and published in accordance with Army regulations. The regulations governing the publication of research findings include:
AR 70-31 "Standards for Technical Reporting"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN4633_AR70-31_WEB_Final.pdf
AR 360-1 "The Army Public Affairs Program"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN6644_AR360-1_Admin_WEB_FINAL.pdf
AR 530-1 "Operations Security"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/r530_1.pdf

Professional scientists are encouraged to publish papers in peer reviewed journals. All publications must obtain the necessary command and public affairs permission before submission. Release of DoD publications is guided by DoD Directive 5230.09, Clearance of DoD Information for Public Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf) and DoD Instruction 5320.29, Security and Policy Review of DoD Information for Public Release (http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf).

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months (include authors, titles and full references.)

1. Buckley PE, Calm AM, Welsh H, Thompson R, Menking D, Carney J, Warner C, Zacharko M. DARPA Antibody Technology Program, Phase II: Characterization of an Anti-BclA Antibody Produced by U.S. Naval Research Laboratory. Combat Capabilities Development Command – Chemical Biological Center. 2019, CCDC CBC-TR-1570. DOI: https://apps.dtic.mil/dtic/tr/fulltext/u2/1074346.pdf
2. Buckley PE, Calm AM, Welsh H, Thompson R, Menking D, Carney J, Warner C, Zacharko, M. DARPA Antibody Technology Program, Phase II: Characterization of an Anti-HA33A Human Immunoglobulin G Antibody Produced by AnaptysBio, Inc. Combat Capabilities Development Command – Chemical Biological Center. 2019, CCDC CBC-TR-1571. DOI: https://apps.dtic.mil/dtic/tr/fulltext/u2/1074350.pdf.
3. Chandrasekar R, Lapin ZJ, Nichols AS, Braun RM, Fountain AW. Photonic integrated circuits for Department of Defense-relevant chemical and biological sensing applications: state-of-the-art and future outlooks. Opt Eng. 2019;58(2): 020901. https://doi.org/10.1117/1.OE.58.2.020901
4. Cole SD, Beabout K, Turner KB, Smith ZK, Funk VL, Harbaugh SV, Liem AT, Roth PA, Geier BA, Emanuel PA, Walper SA, Chavez JL, Lux MW. Quantification of Interlaboratory Cell-Free Protein Synthesis Variability. ACS Synth Biol. 2019;8(9):2080-91. https://www.ncbi.nlm.nih.gov/pubmed/31386355
5. Ibrahim MS, Angelini D, Prugh A, Sickler T, Biggs T, Harris J, Ziemski M. Methods for Inactivation of Venezuelan Equine Encephalitis Virus. Combat Capabilities Development Command – Chemical Biological Center. 2019, CCDC CBC-TR-1579. DOI: https://apps.dtic.mil/dtic/tr/fulltext/u2/1074319.pdf
6. Jabbour RE, Emmons, E, Tripathi A, Kunkel K. Effect of Homoserine Lactones on the Physical Properties of Bacterial Nanocellulose Materials. Combat Capabilities Development Command –

Chemical Biological Center. 2019, CCDC CBC-TR-1566. DOI: https://apps.dtic.mil/dtic/tr/fulltext/u2/1076329.pdf

7. Kesavan J, Kilper G, Williamson M, Alstadt V, Dimmock A, Bascom R. Laboratory Validation and Initial Field Testing of an Unobtrusive Bioaerosol Detector for Health Care Settings. Aerosol Air Qual Res. 2019;19(2):331-44. https://pennstate.pure.elsevier.com/en/publications/laboratory-validation-and-initial-field-testing-of-an-unobtrusive
8. McBride EM, Mach PM, Dhummakupt ES, Dowling S, Carmany DO, Demond PS, Rizzo G, Manicke NE, Glaros T. Paper spray ionization: Applications and perspectives. Trends Analyt Chem. 2019;118:722-30. DOI: https://www.sciencedirect.com/science/article/pii/S0165993619301037
9. Mehta HH, Prater AG, Beabout K, Elworth RAL, Karavis M, Gibbons HS, Shamoo Y. The Essential Role of Hypermutation in Rapid Adaptation to Antibiotic Stress. Antimicrob Agents Chemother. 2019;63(7): e00744-19. DOI: https://aac.asm.org/content/63/7/e00744-19
10. Menking, DL, Fruchey, IR, Buckley, PA, Rhea, KA. Evaluation of the Octet Biolayer Interferometer Platform for Biological Agent Environmental Sampling. Combat Capabilities Development Command – Chemical Biological Center. 2019, CCDC CBC-TR-1585. DOI: https://apps.dtic.mil/dtic/tr/fulltext/u2/1077415.pdf
11. Pomerantz NL, Anderson EE, Dugan NP, Hoffman NF, Barton HF, Lee DT, Oldham CJ, Peterson GW, Parsons GN. Air, Water Vapor, and Aerosol Transport through Textiles with Surface Functional Coatings of Metal Oxides and Metal-Organic Frameworks. ACS Appl Mater Interfaces. 2019;11(27):24683-90. DOI: https://pubs.acs.org/doi/10.1021/acsami.9b04091
12. Wichert WRA, Dhummakupt ES, Zhang CS, Mach PM, Bernhards RC, Glaros T, Manicke NE. Detection of Protein Toxin Simulants from Contaminated Surfaces by Paper Spray Mass Spectrometry. J Am Soc Mass Spectrom. 2019;30(8):1406-15. DOI: https://link.springer.com/article/10.1007/s13361-019-02141-6

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: Development of non-medical defensive material against biological agents including: research, development, and engineering for methods of rapid detection, identification, decontamination, and physical protection from biological threat agents. Additional information is available at https://www.cbc.ccdc.army.mil/.

Microorganisms and/or Toxins Studied: Select Agents and Toxins (HHS and Overlap Select Agents, NIAID Category A pathogens, and HHS Select Toxins) and Simulants

Outdoor Studies: None

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
U.S. Army Medical Research Institute of Chemical Defense (USAMRICD)

2. Where is it located (provide both address and geographical location)?
2900 Ricketts Point Road, Aberdeen Proving Ground, Maryland 21010

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	315 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	315 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	18
(ii)	**Division of personnel:**	
	Military	1
	Civilian	17
(iii)	**Division of personnel by category:**	
	Scientists	3
	Engineers	0
	Technicians	15
	Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Biochemistry, Molecular Biology, Pharmacology, Physiology, Neurotoxicology, Neuroscience

(v) Are contractor staff working in the facility? If so, provide an approximate number:
Yes Number: 15

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Defense (DoD) – Partly;
U.S. National Institutes of Health (NIH)

(vii) What are the funding levels for the following program areas:

Research	\$ 650,000
Development	\$ 0
Test and evaluation	\$ 0
Total	\$ 650,000

(viii) Briefly describe the publication policy of the facility:
It is Army policy to encourage scientific and technical personnel to publish research procedures and results in recognized professional journals as well as present their work at national and international

professional meetings. Such publication is an important part of the Army's research and development program.

Publications are prepared and published in accordance with Army regulations. The regulations governing the publication of research findings include:
AR 70-31 "Standards for Technical Reporting"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN4633_AR70-31_WEB_Final.pdfAR 360-1 "The Army Public Affairs Program"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN6644_AR360-1_Admin_WEB_FINAL.pdfAR 530-1 "Operations Security"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/r530_1.pdf

Professional scientists are encouraged to publish papers in peer reviewed journals. All publications must obtain the necessary command and public affairs permission before submission. Release of DoD publications is guided by DoD Directive 5230.09, Clearance of DoD Information for Public Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf) and DoD Instruction 5320.29, Security and Policy Review of DoD Information for Public Release (http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf).

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

None

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

Objectives: Discover and develop medical products and knowledge solutions against toxin threats through research, education and training, and consultation. USAMRICD performs comprehensive, basic scientific research using established and emerging technologies that support the transition of products to advanced development; develops education and training capabilities for military, interagency, domestic, and international personnel in the medical management of chemical casualties; and provides a venue for mutually beneficial collaboration with external investigators and interagency partners to conduct medical chemical defense research against chemical warfare agents and toxins. See more at: http://usamricd.apgea.army.mil/

Microorganisms and/or Toxins Studied**:** HHS Select Toxin

Outdoor Studies: None

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?

U.S. Army Medical Research Institute of Infectious Diseases (USAMRIID)

2. Where is it located (provide both address and geographical location)?

1425 Porter Street, Fort Detrick, Frederick, Maryland 21702

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	26,026 m^2
BSL-3:	3,139 m^2
BSL-4:	1,186 m^2
Total laboratory floor area:	30,351 m2

4. The organizational structure of each facility:

(i)	**Total number of personnel**	746
(ii)	**Division of personnel:**	
	Military	182
	Civilian	564
(iii)	**Division of personnel by category:**	
	Scientists	202
	Engineers	5
	Technicians	311
	Administrative and support staff	228

(iv) List the scientific disciplines represented in the scientific/engineering staff.

Aerobiology, Biochemistry, Chemistry, Clinical Immunology, Entomology, Genetics, Immunology, Microbiology, Molecular Biology, Toxicology, Veterinary Medicine, Virology.

(v) Are contractor staff working in the facility? If so, provide an approximate number.

Yes Number: 339

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?

U.S. Department of Defense (DoD) – Partly
U.S. Department of Homeland Security (DHS)
U.S. Department of Health and Human Services (DHHS)
U.S. Department of Agriculture (USDA)
U.S. Department of Energy (DoE)
Universities
Private sector companies

(vii) What are the funding levels for the following programme areas:

Research	$ 1,680,576.90
Development	$ 42,861,912.55*
Test and evaluation	$ 13,070,705.55

Total	$ 57,613,195.00

*Includes reimbursables from Cooperative Research and Development Agreements and other Departments, which cannot be differentiated by the above categories.

(viii) Briefly describe the publication policy of the facility:

It is Army policy to encourage scientific and technical personnel to publish research procedures and results in recognized professional journals as well as present their work at national and international professional meetings. Such publication is an important part of the Army's research and development program.

Publications are prepared and published in accordance with Army regulations. The regulations governing the publication of research findings include:
AR 70-31 "Standards for Technical Reporting"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN4633_AR70-31_WEB_Final.pdf
AR 360-1 "The Army Public Affairs Program"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/ARN6644_AR360-1_Admin_WEB_FINAL.pdf
AR 530-1 "Operations Security"
https://armypubs.army.mil/epubs/DR_pubs/DR_a/pdf/web/r530_1.pdf
Professional scientists are encouraged to publish papers in peer reviewed journals. All publications must obtain the necessary command and public affairs permission before submission. Release of DoD publications is guided by DoD Directive 5230.09, Clearance of DoD Information for Public Release (https://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf) and DoD Instruction 5320.29, Security and Policy Review of DoD Information for Public Release (http://www.esd.whs.mil/Portals/54/Documents/DD/issuances/dodi/523029p.pdf).

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months (include authors, titles and full references.)

1. Abudurexiti, A, Adkins, S, Alioto, D, Alkhovsky, SV, Avšič-Županc, et al. Taxonomy of the order Bunyavirales: update 2019. *Arch Virol.* 2019;164(7):1949-1965. DOI: https://link.springer.com/article/10.1007%2Fs00705-019-04253-6
2. Akhvlediani, T, Chitadze, N, Chlikadze, R, Rostiashvili, N, Betashvili, M, et al. Multivariate relationships between epidemiologic risk factors and zoonotic infections among military personnel in the country of Georgia: A non-linear canonical correlation analysis. *Zoonoses Public Health.* 2019;66(7):835-841. DOI: https://www.ncbi.nlm.nih.gov/pubmed/31338987
3. Amarasinghe, GK, Ayllón, MA, Bào, Y, Basler, CF, Bavari, S, et al. Taxonomy of the order Mononegavirales: update 2019. *Arch Virol.* 2019;164(7):1967-1980. DOI: https://link.springer.com/article/10.1007/s00705-019-04247-4
4. Amemiya, K, Dankmeyer, JL, Biryukov, SS, Trevino, SR, Klimko, CP, et al. Deletion of two genes in Burkholderia pseudomallei MSHR668 that target essential amino acids protect acutely infected BALB/c mice and promote long term survival. *Vaccines (Basel).* 2019;7(4). DOI: https://www.mdpi.com/2076-393X/7/4/196
5. Atre, T, Phillips, RL, Modjarrad, K, Regules, JA, Bergmann-Leitner, ES. Development and characterization of a Zaire Ebola (ZEBOV) specific IgM ELISA. *J Immunol Methods.* 2019;468:29-34. DOI: https://www.ncbi.nlm.nih.gov/pubmed/30910536
6. Bachert, BA, Biryukov, SS, Chua, J, Rodriguez, SA, Toothman, RG, Jr., et al. A Francisella novicida mutant, lacking the soluble lytic transglycosylase Slt, exhibits defects in both growth and virulence.

Front Microbiol. 2019;10:1343. DOI: https://www.frontiersin.org/articles/10.3389/fmicb.2019.01343/full

7. Barnes, KB, Zumbrun, SD, Halasohoris, SA, Desai, PD, Miller, LL, et al. Demonstration of the broad spectrum in vitro activity of finafloxacin against pathogens of biodefence interest. *Antimicrob Agents Chemother.* 2019. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6879258/
8. Bazzill, JD, Stronsky, SM, Kalinyak, LC, Ochyl, LJ, Steffens, JT, et al. Vaccine nanoparticles displaying recombinant Ebola virus glycoprotein for induction of potent antibody and polyfunctional T cell responses. *Nanomedicine.* 2019;18:414-425. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1549963418305562?via%3Dihub
9. Beitzel, B, Hulseberg, CE, Palacios, G. Reverse genetics systems as tools to overcome the genetic diversity of Lassa virus. *Curr Opin Virol.* 2019;37:91-96. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1879625719300379?via%3Dihub
10. Blair, PW, Kuhn, JH, Pecor, DB, Apanaskevich, DA, Kortepeter, MG, et al. An emerging biothreat: Crimean-Congo hemorrhagic fever virus in Southern and Western Asia. *Am J Trop Med Hyg.* 2019;100(1):16-23. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6335890/
11. Bocan, TM, Basuli, F, Stafford, RG, Brown, JL, Zhang, X, et al. Synthesis of [18 F]Favipiravir and Biodistribution in C3H/HeN mice as assessed by Positron Emission Tomography. *Sci Rep.* 2019;9(1). DOI: https://www.nature.com/articles/s41598-018-37866-z
12. Bocan, TM, Stafford, RG, Brown, JL, Akuoku Frimpong, J, Basuli, F, , et al. Characterization of brain inflammation, apoptosis, hypoxia, blood-brain barrier integrity and metabolism in Venezuelan equine encephalitis virus (VEEV TC-83) exposed mice by in vivo positron emission tomography imaging. *Viruses.* 2019;11(11). DOI: https://www.mdpi.com/1999-4915/11/11/1052
13. Bornholdt, ZA, Herbert, AS, Mire, CE, He, S, Cross, RW, et al. A two-antibody pan-Ebolavirus cocktail confers broad therapeutic protection in ferrets and nonhuman primates. *Cell Host Microbe.* 2019;25(1):49-58.e45. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6341996/
14. Bose, ME, Shrivastava, S, He, J, Nelson, MI, Bera, J, et al. Sequencing and analysis of globally obtained human parainfluenza viruses 1 and 3 genomes. *PLoS ONE.* 2019;14(7). DOI: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0220057
15. Bournazos, S, DiLillo, DJ, Goff, AJ, Glass, PJ, Ravetch, JV. Differential requirements for FcγR engagement by protective antibodies against Ebola virus. *Proc Natl Acad Sci U S A.* 2019;116(40):20054-20062. DOI: https://www.pnas.org/content/116/40/20054.long
16. Bower, WA, Schiffer, J, Atmar, RL, Keitel, WA, Friedlander, AM, et al. Use of Anthrax Vaccine in the United States: recommendations of the Advisory Committee on Immunization Practices, 2019. *MMWR Recomm Rep.* 2019;68(4):1-14. DOI: https://www.cdc.gov/mmwr/volumes/68/rr/rr6804a1.htm
17. Brannan, JM, He, S, Howell, KA, Prugar, LI, Zhu, W, et al. Post-exposure immunotherapy for two ebolaviruses and Marburg virus in nonhuman primates. *Nat Commun.* 2019;10(1):105. DOI: https://www.nature.com/articles/s41467-018-08040-w
18. Brocato, RL, Hooper, JW. Progress on the prevention and treatment of hantavirus disease. *Viruses.* 2019;11(7):E610. DOI: https://www.mdpi.com/1999-4915/11/7/610
19. Burke, CW, Froude, JW, Rossi, F, White, CE, Moyer, CL, et al. Therapeutic monoclonal antibody treatment protects nonhuman primates from severe Venezuelan equine encephalitis virus disease after aerosol exposure. *PLoS Pathog.* 2019;15(12):e1008157. DOI: https://journals.plos.org/plospathogens/article?id=10.1371/journal.ppat.1008157
20. Caì, Y, Yú, S, Jangra, RK, Postnikova, EN, Wada, J, et al. Human, nonhuman primate, and bat cells are broadly susceptible to tibrovirus particle cell entry. *Front Microbiol.* 2019;10(APR). DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6499107/
21. Calisher, CH, Briese, T, Brister, JR, Charrel, RN, Durrwald, R, et al. Strengthening the interaction of the virology community with the International Committee on Taxonomy of Viruses (ICTV) by

linking virus names and their abbreviations to virus species. *Syst Biol.* 2019;68(5):828-839. DOI: https://academic.oup.com/sysbio/article/68/5/828/5267841

22. Choi, JY, Hii, KC, Bailey, ES, Chuang, JY, Tang, WY, et al. Burkholderia pseudomallei detection among hospitalized patients, Sarawak. *Am J Trop Med Hyg.* 2019. DOI: http://www.ajtmh.org/content/journals/10.4269/ajtmh.19-0625
23. Chua, J, Bozue, JA, Klimko, CP, Shoe, JL, Ruiz, SI, et al. Formaldehyde and glutaraldehyde inactivation of bacterial tier 1 select agents in tissues. *Emerg Infect Dis.* 2019;25(5):919-926. DOI: https://wwwnc.cdc.gov/eid/article/25/5/18-0928_article
24. Clements, TL, Rossi, CA, Irish, AK, Kibuuka, H, Eller, LA, et al. Chikungunya and o'nyong-nyong viruses in Uganda: implications for diagnostics. *Open Forum Infect Dis.* 2019;6(3). DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6411207/
25. Cooper, TK, Huzella, L, Johnson, JC, Rojas, O, Yellayi, S, , et al. Author Correction: Histology, immunohistochemistry, and in situ hybridization reveal overlooked Ebola virus target tissues in the Ebola virus disease guinea pig model. *Sci Rep.* 2019;9(1):15013. DOI: https://www.nature.com/articles/s41598-019-51386-4
26. Culbreth, MJ, Biryukov, SS, Shoe, JL, Dankmeyer, JL, Hunter, M, et al. The Use of analgesics during vaccination with a live attenuated Yersinia pestis vaccine alters the resulting immune response in mice. *Vaccines (Basel).* 2019;7(4):E205. DOI: https://www.mdpi.com/2076-393X/7/4/205
27. Davis, AZ, Jaffe, DA, Honadel, TE, Lapsley, WD, Wilber-Raymond, JL, et al. Prevalence of Bartonella sp. in United States military working dogs with infectious endocarditis: a retrospective case-control study. *J Vet Cardiol.* 2019;27:1-9. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1760273419301468?via%3Dihub
28. DeShazer, D. A novel contact-independent T6SS that maintains redox homeostasis via Zn2+ and Mn2+ acquisition is conserved in the Burkholderia pseudomallei complex. *Microbiol Res.* 2019;226:48-54. DOI: https://www.sciencedirect.com/science/article/pii/S0944501319303192?via%3Dihub
29. DeShazer, D, Lovett, S, Richardson, J, Koroleva, G, Kuehl, K, et al. Bacteriophage-associated genes responsible for the widely divergent phenotypes of variants of Burkholderia pseudomallei strain MSHR5848. *J Med Microbiol.* 2019;68(2):263-278. DOI: https://www.microbiologyresearch.org/content/journal/jmm/10.1099/jmm.0.000908
30. Diagne, MM, Ndione, MHD, Di Paola, N, Fall, G, Bedekelabou, AP, et al. Usutu virus isolated from rodents in Senegal. *Viruses.* 2019;11(2):E181. DOI: https://www.mdpi.com/1999-4915/11/2/181
31. Espy, N, Nagle, E, Pfeffer, B, Garcia, K, Chitty, AJ, et al. T-705 induces lethal mutagenesis in Ebola and Marburg populations in macaques. *Antiviral Res.* 2019;170:104529. DOI: https://www.sciencedirect.com/science/article/abs/pii/S0166354219303109?via%3Dihub
32. Fan, Y, Stronsky, SM, Xu, Y, Steffens, JT, van Tongeren, SA, et al. Multilamellar vaccine particle elicits potent immune activation with protein antigens and protects mice against Ebola virus infection. *ACS Nano.* 2019;13(10): 11087-11096. DOI: https://pubs.acs.org/doi/10.1021/acsnano.9b03660
33. Fathy Mohamed, Y, Scott, NE, Molinaro, A, Creuzenet, C, Ortega, X, et al. A general protein O-glycosylation machinery conserved in Burkholderia species improves bacterial fitness and elicits glycan immunogenicity in humans. *J Biol Chem.* 2019;294(36):13248-13268. DOI: https://www.jbc.org/content/early/2019/07/26/jbc.RA119.009671.short
34. Fries, L, Cho, I, Krahling, V, Fehling, SK, Strecker, T, et al. Randomized, blinded, dose-ranging trial of an Ebola virus glycoprotein (EBOV GP) nanoparticle vaccine with Matrix-M adjuvant in healthy adults. *J Infect Dis.* 2019 Oct 11:jiz518. [Epub ahead of print]. DOI: https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiz518/5585635
35. Fukuda, H, Li, S, Sardo, L, Smith, JL, Yamashita, K, et al. Structural determinants of the APOBEC3G N-terminal domain for HIV-1 RNA association. *Front Cell Infect Microbiol.* 2019;9:129. DOI: https://www.frontiersin.org/articles/10.3389/fcimb.2019.00129/full

36. Garrison, AR, Smith, DR, Golden, JW. Animal models for Crimean-Congo hemorrhagic fever human disease. *Viruses*. 2019;11(7):E590. DOI: https://www.mdpi.com/1999-4915/11/7/590
37. Gilkes, AP, Albin, TJ, Manna, S, Supnet, M, Ruiz, S, et al. Tuning subunit vaccines with novel TLR triagonist adjuvants to generate protective immune responses against Coxiella burnetii. *J Immunol*. 2019 Dec 23:ji1900991. [Epub ahead of print]. DOI: https://www.jimmunol.org/content/early/2019/12/21/jimmunol.1900991
38. Golden, JW, Shoemaker, CJ, Lindquist, ME, Zeng, XK, Daye, SP, et al. GP38-targeting monoclonal antibodies protect adult mice against lethal Crimean-Congo hemorrhagic fever virus infection. *Sci Adv*. 2019;5(7):eaaw9535. DOI: https://advances.sciencemag.org/content/5/7/eaaw9535
39. Gomes-Solecki, M, Arnaboldi, PM, Backenson, PB, Benach, JL, Cooper, CL, et al. Protective immunity and new vaccines for Lyme disease. *Clin Infect Dis*. 2019 Oct 17:ciz872. [Epub ahead of print]. DOI: https://academic.oup.com/cid/advance-article/doi/10.1093/cid/ciz872/5588349
40. Grubaugh, ND, Saraf, S, Gangavarapu, K, Watts, A, Tan, AL, et al. Travel surveillance and genomics uncover a hidden Zika outbreak during the waning epidemic. *Cell*. 2019;178(5):1057-1071.e1011. DOI: https://www.sciencedirect.com/science/article/pii/S0092867419307834?via%3Dihub
41. Happi, AN, Happi, CT, Schoepp, RJ. Lassa fever diagnostics: past, present, and future. *Curr Opin Virol*. 2019;37:132-138. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1879625719300677
42. Haston, JC, Rostad, CA, Jerris, RC, Milla, SS, McCracken, C, et al. Prospective cohort study of next-generation sequencing as a diagnostic modality for unexplained encephalitis in children. *J Pediatric Infect Dis Soc*. 2019 May 20:piz032. [Epub ahead of print]. DOI: https://academic.oup.com/jpids/advance-article-abstract/doi/10.1093/jpids/piz032/5492331?redirectedFrom=fulltext
43. Hogan, M, Bahta, M, Tsuji, K, Nguyen, TX, Cherry, S, et al. Targeting protein-protein interactions of tyrosine phosphatases with microarrayed fragment libraries displayed on phosphopeptide substrate scaffolds. *ACS Comb Sci*. 2019;21(3):158-170. DOI: https://pubs.acs.org/doi/10.1021/acscombsci.8b00122
44. Hulseberg, CE, Fénéant, L, Szymanska-De Wijs, KM, Kessler, NP, Nelson, EA, et al. Arbidol and other low-molecular-weight drugs that inhibit Lassa and Ebola viruses. *J Virol*. 2019;93(8):e02185-18. DOI: https://jvi.asm.org/content/93/8/e02185-18
45. Jasenosky, LD, Cadena, C, Mire, CE, Borisevich, V, Haridas, V, et al. The FDA-approved oral drug nitazoxanide amplifies host antiviral responses and inhibits Ebola virus. *iScience*. 2019;19:1279-1290. DOI: https://www.sciencedirect.com/science/article/pii/S2589004219302287
46. Jiang, JJ, Banglore, P, Cashman, KA, Schmaljohn, CS, Schultheis, K, et al. Immunogenicity of a protective intradermal DNA vaccine against Lassa virus in cynomolgus macaques. *Hum Vaccin Immunother*. 2019;15(9):2066-2074. DOI: https://www.tandfonline.com/doi/full/10.1080/21645515.2019.1616499
47. Katawera, V, Kohar, H, Mahmoud, N, Raftery, P, Wasunna, C, et al. Enhancing laboratory capacity during Ebola virus disease (EVD) heightened surveillance in Liberia: lessons learned and recommendations. *Pan Afr Med J*. 2019;33(suppl 2):8. DOI: https://www.panafrican-med-journal.com/content/series/33/2/8/full/
48. Kayiwa, JT, Nankya, AM, Ataliba, I, Nassuna, CA, Omara, IE, et al. Dengue fever and chikungunya virus infections: identification in travelers in Uganda - 2017. *Trop Dis Travel Med Vaccines*. 2019;5:21. DOI: https://tdtmvjournal.biomedcentral.com/articles/10.1186/s40794-019-0099-3
49. Keasey, SL, Suh, MJ, Das, S, Blancett, CD, Zeng, X, et al. Decreased antibiotic susceptibility driven by global remodeling of the klebsiella pneumoniae proteome. *Mol Cell Proteomics*. 2019;18(4):657-668. DOI: https://www.mcponline.org/content/18/4/657
50. Kende, M, Paragas, J, Salazar, AM. The efficacy of poly-ICLC against Ebola-Zaire virus (EBOV) infection in mice and cynomolgus monkeys. *Antiviral Res*. 2019;163:179-184. DOI: https://www.sciencedirect.com/science/article/abs/pii/S0166354218304078?via%3Dihub

51. Khan, M, Miller, C, Hale, M. Development of an assay for antimicrobial susceptibility testing of Coxiella burnetii. *Abstr Pap Am Chem Soc.* 2019;257. DOI: https://mdsoar.org/bitstream/handle/11603/13530/Draft%2012%20Departmental%20Honors%20Paper%20Khan%20%281%29.pdf?sequence=1&isAllowed=y
52. Kijek, TM, Mou, S, Bachert, BA, Kuehl, KA, Williams, JA, et al. The D-alanyl-D-alanine carboxypeptidase enzyme is essential for virulence in the Schu S4 strain of Francisella tularensis and a dacD mutant is able to provide protection against a pneumonic challenge. *Microb Pathog.* 2019;137: 103742. DOI: https://www.sciencedirect.com/science/article/abs/pii/S0882401019310587?via%3Dihub
53. Kim, WK, No, JS, Lee, D, Jung, J, Park, H, et al. Active targeted surveillance to identify sites of emergence of Hantavirus. *Clin Infect Dis.* 2019 Mar 20:ciz234. [Epub ahead of print]. DOI: https://www.ncbi.nlm.nih.gov/pubmed/30891596
54. Kinoshita, Y, Cloutier, AK, Rozak, DA, Khan, MSR, Niwa, H, et al. A novel selective medium for the isolation of Burkholderia mallei from equine specimens. *BMC Vet Res.* 2019;15(1):133. DOI: https://bmcvetres.biomedcentral.com/articles/10.1186/s12917-019-1874-055. Ko, SY, Akahata, W, Yang, ES, Kong, WP, Burke, CW, et al. A virus-like particle vaccine prevents equine encephalitis virus infection in nonhuman primates. *Sci Transl Med.* 2019;11(492):eaav3113. DOI: https://stm.sciencemag.org/content/11/492/eaav3113.short
56. Krakauer, T. Staphylococcal superantigens: Pyrogenic toxins induce toxic shock. *Toxins.* 2019;11(3). DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6468478/
57. Krishnamurthy, M, Lemmon, MM, Falcinelli, EM, Sandy, RA, Dootz, JN, et al. Enhancing the antibacterial activity of polymyxins using a nonantibiotic drug. *Infect Drug Resist.* 2019;12:1393-1405. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6555264/
58. Kuhn, JH, Amarasinghe, GK, Basler, CF, Bavari, S, Bukreyev, A, et al. ICTV virus taxonomy profile: Filoviridae. *J Gen Virol.* 2019;100(6):911-912. DOI: https://www.ncbi.nlm.nih.gov/pubmed/31021739
59. Larson, GP, Tran, V, Yu, SQ, Cai, YY, Higgins, CA, et al. EPS8 facilitates uncoating of influenza A virus. *Cell Reports.* 2019;29(8):2175-2183.e4. DOI: https://www.sciencedirect.com/science/article/pii/S2211124719313786?via%3Dihub
60. Lindquist, ME, Hicar, MD. B Cells and antibodies in Kawasaki disease. *Int J Mol Sci.* 2019;20(8):E1834. DOI: https://www.mdpi.com/1422-0067/20/8/1834/htm
61. Liu, J, Coffin, KM, Johnston, SC, Babka, AM, Bell, TM, et al. Nipah virus persists in the brains of nonhuman primate survivors. *JCI Insight.* 2019;4(14):129629. DOI: https://insight.jci.org/articles/view/129629
62. Maes, P, Adkins, S, Alkhovsky, SV, Avšič-Županc, T, Ballinger, MJ, et al. Taxonomy of the order Bunyavirales: second update 2018. *Arch Virol.* 2019;164(3):927-941. DOI: https://link.springer.com/article/10.1007%2Fs00705-018-04127-3
63. Maes, P, Amarasinghe, GK, Ayllón, MA, Basler, CF, Bavari, S, et al. Taxonomy of the order Mononegavirales: second update 2018. *Arch Virol.* 2019;164(4):1233-1244. DOI: https://link.springer.com/article/10.1007%2Fs00705-018-04126-4
64. Martins, KA, Gregory, MK, Valdez, SM, Sprague, TR, Encinales, L, et al. Neutralizing antibodies from convalescent chikungunya virus patients can cross-neutralize Mayaro and Una Viruses. *Am J Trop Med Hyg.* 2019;100(6):1541-1544. DOI: https://www.ncbi.nlm.nih.gov/pubmed/31017081
65. Mbala-Kingebeni, P, Aziza, A, Di Paola, N, Wiley, MR, Makiala-Mandanda, S, et al. Medical countermeasures during the 2018 Ebola virus disease outbreak in the North Kivu and Ituri Provinces of the Democratic Republic of the Congo: a rapid genomic assessment. *Lancet Infect Dis.* 2019;19(6):648-657. DOI: https://www.sciencedirect.com/science/article/pii/S1473309919301185?via%3Dihub
66. Mbala-Kingebeni, P, Pratt, CB, Wiley, MR, Diagne, MM, Makiala-Mandanda, S, et al. 2018 Ebola virus disease outbreak in Équateur Province, Democratic Republic of the Congo: a retrospective

genomic characterisation. *Lancet Infect Dis.* 2019;19(6):641-647. DOI: https://www.thelancet.com/pdfs/journals/laninf/PIIS1473-3099(19)30124-0.pdf

67. McCall, S, Kreindl, G, Kastinger, T, Muller, E, Zahrer, W, et al. Rudolf Hess - the Doppelganger conspiracy theory disproved. *Forensic Sci Int Genet.* 2019;40:18-22. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1872497317302971?via%3Dihub
68. Miller, CN, Khan, M, Ahmed, SA, Kota, K, Panchal, RG, Hale, ML. Development of a Coxiella burnetii culture method for high-throughput assay to identify host-directed therapeutics. *J Microbiol Methods.* 2019 Dec 17;169:105813-105813. [Epub ahead of pirnt]. DOI: https://www.sciencedirect.com/science/article/pii/S0167701219310085?via%3Dihub
69. Mohamed, YF, Scott, NE, Molinaro, A, Creuzenet, C, Ortega, X, et al. A general protein O-glycosylation machinery conserved in Burkholderia species improves bacterial fitness and elicits glycan immunogenicity in humans. *J Biol Chem.* 2019;294(36):13248-13268. DOI: https://www.jbc.org/content/early/2019/07/26/jbc.RA119.009671.abstract
70. Morazzani, EM, Compton, JR, Leary, DH, Berry, AV, Hu, X, et al. Proteolytic cleavage of host proteins by the Group IV viral proteases of Venezuelan equine encephalitis virus and Zika virus. *Antiviral Res.* 2019;164:106-122. DOI: https://www.sciencedirect.com/science/article/pii/S016635421830603X?via%3Dihub
71. Morwitzer, MJ, Tritsch, SR, Cazares, LH, Ward, MD, Nuss, JE, Bavari, S, Reid, SP. Identification of RUVBL1 and RUVBL2 as novel cellular interactors of the Ebola virus nucleoprotein. *Viruses.* 2019;11(4):E372. DOI: https://www.mdpi.com/1999-4915/11/4/372/htm
72. Nalca, A, Totura, A, Livingston, V, Frick, O, Dyer, D. African green monkey model of Middle East respiratory syndrome coronavirus (MERS-CoV) infection. *Int J Infect Dis.* 2019;79(suppl 1):99-100. DOI: https://www.ijidonline.com/article/S1201-9712(18)34828-8/fulltext
73. Naluyima, P, Kayondo, W, Ritchie, C, Wandege, J, Kagabane, S, et al. The Joint Mobile Emerging Disease Clinical Capability (JMEDICC) laboratory approach: capabilities for high-consequence pathogen clinical research. *PLoS Negl Trop Dis.* 2019;13(12):e0007787. DOI: https://journals.plos.org/plosntds/article?id=10.1371/journal.pntd.0007787
74. Natesan, M, Wu, SW, Chen, CI, Jensen, SMR, Karlovac, N, et al. A Smartphone-Based Rapid Telemonitoring System for Ebola and Marburg Disease Surveillance. *Acs Sens.* 2019;4(1):61-68. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6350200/
75. Nimo-Paintsil, SC, Fichet-Calvet, E, Borremans, B, Letizia, AG, Mohareb, E, et al. Rodent-borne infections in rural Ghanaian farming communities [published correction appears in *PLoS One*. 2019;14(6):e0218271]. *PLoS ONE.* 2019;14(4):e0215224. DOI: https://www.ncbi.nlm.nih.gov/pubmed/31017931
76. No, JS, Kim, WK, Cho, S, Lee, SH, Kim, JA, et al. Comparison of targeted next-generation sequencing for whole-genome sequencing of Hantaan orthohantavirus in Apodemus agrarius lung tissues. *Sci Rep.* 2019;9(1):16631. DOI: https://www.nature.com/articles/s41598-019-53043-2
77. Olson, MA, Legler, PM, Zabetakis, D, Turner, KB, Anderson, GP, Goldman, ER. Sequence tolerance of a single-domain antibody with a high thermal stability: comparison of computational and experimental fitness profiles. *ACS Omega.* 2019;4(6):10444-10454. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6648363/
78. Pandya, UM, Egbuta, C, Norman, TMA, Chiang, CY, Wiersma, VR, et al. The biophysical interaction of the danger-associated molecular pattern (DAMP) calreticulin with the pattern-associated molecular pattern (PAMP) lipopolysaccharide. *Int J Mol Sci.* 2019;20(2):E408. DOI: https://www.mdpi.com/1422-0067/20/2/408/htm
79. Perez-Sautu, U, Wiley, MR, Iglesias-Caballero, M, Pozo, F, Prieto, K, et al. Target-independent high-throughput sequencing methods provide evidence that already known human viral pathogens play a main role in respiratory infections with unexplained etiology. *Emerg Microbes Infect.* 2019;8(1):1054-1065. DOI: https://www.tandfonline.com/doi/full/10.1080/22221751.2019.1640587

80. Perley, CC, Brocato, RL, Kwilas, SA, Daye, S, Moreau, A, et al. Three asymptomatic animal infection models of hemorrhagic fever with renal syndrome caused by hantaviruses. *PLoS One.* 2019;14(5):e0216700. DOI: https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0216700
81. Pessi, A, Bixler, SL, Soloveva, V, Radoshitzky, S, Retterer, C, et al. Cholesterol-conjugated stapled peptides inhibit Ebola and Marburg viruses in vitro and in vivo. *Antiviral Res.* 2019;171:104592. DOI: https://www.sciencedirect.com/science/article/pii/S0166354219302992?via%3Dihub
82. Philip, CO, Koech, M, Kipkemoi, N, Kirera, R, Ndonye, J, et al. Evaluation of the performance of a multiplex reverse transcription polymerase chain reaction kit as a potential diagnostic and surveillance kit for rotavirus in Kenya. *Trop Dis Travel Med Vaccines.* 2019;5:12. DOI: https://tdtmvjournal.biomedcentral.com/articles/10.1186/s40794-019-0087-7
83. Pittman, PR, Hahn, M, Lee, HS, Koca, C, Samy, N, et al. Phase 3 efficacy trial of modified vaccinia Ankara as a vaccine against smallpox. *N Engl J Med.* 2019;381(20):1897-1908. DOI: https://www.nejm.org/doi/full/10.1056/NEJMoa1817307
84. Pleet, ML, DeMarino, C, Stonier, SW, Dye, JM, Jacobson, S, Aman, MJ, Kashanchi, F. Extracellular vesicles and ebola virus: A new mechanism of immune evasion. *Viruses.* 2019;11(5):E410. DOI: https://www.mdpi.com/1999-4915/11/5/410/htm
85. Prescott, J, Guito, JC, Spengler, JR, Arnold, CE, Schuh, AJ, et al. Rousette bat dendritic cells overcome Marburg virus-mediated antiviral responses by upregulation of interferon-related genes while downregulating proinflammatory disease mediators. *mSphere.* 2019;4(6):e00728-19. DOI: https://msphere.asm.org/content/4/6/e00728-19
86. Quiroz, JA, Malonis, RJ, Thackray, LB, Cohen, CA, Pallesen, J, et al. Human monoclonal antibodies against chikungunya virus target multiple distinct epitopes in the E1 and E2 glycoproteins. *PLoS Pathog.* 2019;15(11):e1008061. DOI: https://journals.plos.org/plospathogens/article?id=10.1371%2Fjournal.ppat.1008061
87. Rajamani, S, Sandy, R, Kota, K, Lundh, L, Gomba, G, et al. Robust biofilm assay for quantification and high throughput screening applications. *J Microbiol Methods.* 2019;159:179-185. DOI: https://www.sciencedirect.com/science/article/pii/S0167701219300296
88. Ramirez de Arellano, E, Sanchez-Lockhart, M, Perteguer, MJ, Bartlett, M, Ortiz, M, et al. First evidence of antibodies against Lloviu virus in Schreiber's bent-winged insectivorous bats demonstrate a wide circulation of the virus in Spain. *Viruses.* 2019;11(4):E360. DOI: https://www.mdpi.com/1999-4915/11/4/360/htm
89. Ricks, KM, Koehler, J, Shoemaker, C, Voorhees, M, Schoepp, R. Development of a sustainable diagnostic toolbox for serosurveillance of West African infectious diseases. *Int J Infect Dis.* 2019;79(suppl 1):24-25. DOI: https://www.sciencedirect.com/science/article/pii/S1201971218346538
90. Ricks, KM, Shoemaker, CJ, Dupuy, LC, Flusin, O, Voorhees, MA, et al. Development of a bead-based immunoassay using virus-like particles for detection of alphaviral humoral response. *J Virol Methods.* 2019;270:12-17. DOI: https://www.sciencedirect.com/science/article/abs/pii/S0166093418305421
91. Rusnak, JM, Glass, PJ, Weaver, SC, Sabourin, CL, Glenn, AM, et al. Approach to strain selection and the propagation of viral stocks for Venezuelan equine encephalitis virus vaccine efficacy testing under the Animal Rule. *Viruses.* 2019;11(9):E807. DOI: https://www.mdpi.com/1999-4915/11/9/807/htm
92. Salami, K, Gouglas, D, Schmaljohn, C, Saville, M, Tornieporth, N. A review of Lassa fever vaccine candidates. *Curr Opin Virol.* 2019;37:105-111. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1879625719300501?via%3Dihub
93. Samsa, MM, Dupuy, LC, Beard, CW, Six, CM, Schmaljohn, CS, et al. Self-amplifying RNA vaccines for Venezuelan equine encephalitis virus induce robust protective Immunogenicity in mice. *Mol Ther.* 2019;27(4):850-865. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1525001619300012?via%3Dihub

94. Scarff, JM, Waidyarachchi, SL, Meyer, CJ, Lane, DJ, Chai, W, et al. Aminomethyl spectinomycins: a novel antibacterial chemotype for biothreat pathogens. *J Antibiot (Tokyo).* 2019;72(9):693-701. DOI: https://www.nature.com/articles/s41429-019-0194-8
95. Schmaljohn, C, Safronetz, D. Editorial overview: Lassa virus. *Curr Opin Virol.* 2019;37:vii-ix. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1879625719300835?via%3Dihub
96. Schubert, SL, Melanson, VR. Prevalence of Lyme disease attributable to military service at the USMA, West Point NY: FY2016-2018. *Mil Med.* 2019 Jun 27:usz156. [Epub ahead of print]. DOI: https://academic.oup.com/milmed/article/185/1-2/e28/5524322
97. Shearer, JD, Saylor, ML, Butler, CM, Treston, AM, Heine, HS, et al. GC-072: A novel therapeutic candidate for oral treatment of melioidosis and infections caused by select biothreat pathogens. *Antimicrob Agents Chemother.* 2019;63(12):e00834-19. DOI: https://aac.asm.org/content/63/12/e00834-19.long
98. Sichtig, H, Minogue, T, Yan, Y, Stefan, C, Hall, A, et al. FDA-ARGOS is a database with public quality-controlled reference genomes for diagnostic use and regulatory science. *Nat Commun.* 2019;10(1):3313. DOI: https://www.nature.com/articles/s41467-019-11306-6
99. Siddharthan, V, Miao, J, Van Wettere, AJ, Li, R, Wu, H, et al. Human polyclonal antibodies produced from transchromosomal bovine provides prophylactic and therapeutic protections against zika virus infection in STAT2 KO Syrian hamsters. *Viruses.* 2019;11(2):E92. DOI: https://www.mdpi.com/1999-4915/11/2/92/htm
100. Smith, D, Shoemaker, CJ, Garrison, A, Ricks, KM, Flusin, O, et al. The pathogenesis of genetically diverse strains of Crimean-Congo hemorrhagic fever virus in the cynomolgus macaque model. *Int J Infect Dis.* 2019;79(suppl 1):16-16. DOI: https://www.sciencedirect.com/science/article/pii/S1201971218346356
101. Smith, DR, Shoemaker, CJ, Zeng, X, Garrison, AR, Golden, JW, et al. Persistent Crimean-Congo hemorrhagic fever virus infection in the testes and within granulomas of non-human primates with latent tuberculosis. *PLoS Pathog.* 2019;15(9):e1008050. DOI: https://journals.plos.org/plospathogens/article?id=10.1371%2Fjournal.ppat.1008050
102. Sobarzo, A, Stonier, SW, Radinsky, O, Gelkop, S, Kuehne, AI, et al. Multiple viral proteins and immune response pathways act to generate robust long-term immunity in Sudan virus survivors. *EBioMedicine.* 2019;46:215-226. DOI: https://www.sciencedirect.com/science/article/pii/S2352396419304578?via%3Dihub
103. Steger, CL, Brown, ML, Sullivan, OM, Boudreaux, CE, Cohen, CA, LaConte, LEW, McDonald, SM. In vitro double-stranded RNA synthesis by rotavirus polymerase mutants with lesions at core shell contact sites. *J Virol.* 2019;93(20):e01049-19. DOI: https://jvi.asm.org/content/93/20/e01049-19.long
104. Suschak, JJ, Schmaljohn, CS. Vaccines against Ebola virus and Marburg virus: recent advances and promising candidates. *Hum Vaccin Immunother.* 2019;15(10):2359-2377. DOI: https://www.tandfonline.com/doi/full/10.1080/21645515.2019.1651140
105. Totura, AL, Bavari, S. Broad-spectrum coronavirus antiviral drug discovery. *Expert Opin Drug Discov.* 2019;14(4):397-412. DOI: https://www.tandfonline.com/doi/full/10.1080/17460441.2019.1581171
106. Trobaugh, DW, Sun, CQ, Bhalla, N, Gardner, CL, Dunn, M, Klimstra, WB. Cooperativity between the 3' untranslated region microRNA binding sites is critical for the virulence of eastern equine encephalitis virus. *PLoS Pathog.* 2019;15(10):e1007867. DOI: https://journals.plos.org/plospathogens/article?id=10.1371/journal.ppat.1007867
107. Turell, MJ, Gozalo, AS, Guevara, C, Schoeler, GB, Carbajal, F, Lopez-Sifuentes, VM, Watts, DM. Lack of evidence of sylvatic transmission of dengue viruses in the Amazon Rainforest near Iquitos, Peru. *Vector Borne Zoonotic Dis.* 2019;19(9):685-689. DOI: https://www.liebertpub.com/doi/full/10.1089/vbz.2018.2408?url_ver=Z39.88-2003&rfr_id=ori%3Arid%3Acrossref.org&rfr_dat=cr_pub%3Dpubmed&

108. Turner, MJ, Cox, JK, Spellman, AC, Stahl, C, Bavari, S. Avoidance behavior independent of innate-immune signaling seen in Caenorhabditis elegans challenged with Bacillus anthracis. *Dev Comp Immunol.* 2020;102:103453. DOI: https://www.sciencedirect.com/science/article/pii/S0145305X18304579?via%3Dihub
109. Verdonck, S, Pu, SY, Sorrell, FJ, Elkins, JM, Froeyen, M, et al. Synthesis and structure-activity relationships of 3,5-disubstituted-pyrrolo 2,3-b pyridines as inhibitors of adaptor-associated kinase 1 with antiviral activity. *J Med Chem.* 2019;62(12):5810-5831. DOI: https://pubs.acs.org/doi/10.1021/acs.jmedchem.9b00136
110. von Fricken, ME, Qurollo, BA, Boldbaatar, B, Wang, YW, Jiang, RR, et al. Genetic diversity of Anaplasma and Ehrlichia bacteria found in Dermacentor and Ixodes ticks in Mongolia. *Ticks Tick Borne Dis.* 2020;11(1):101316. DOI: https://www.sciencedirect.com/science/article/pii/S1877959X18304771?via%3Dihub
111. Voorhees, M, Ricks, KM, Fulmer, A, Quesinberry, J, Poli, M, Schoepp, R. Development of a multiplexed antigen detection immunoassay for detection of viral agents. *Int J Infect Dis.* 2019;79(suppl 1):106-106. DOI: https://www.ijidonline.com/article/S1201-9712(18)34843-4/fulltext
112. Ward, MD, Brueggemann, EE, Kenny, T, Reitstetter, RE, Mahone, CR, et al. Characterization of the plasma proteome of nonhuman primates during Ebola virus disease or melioidosis: a host response comparison. *Clin Proteomics.* 2019;16:7. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6366079/
113. Wec, AZ, Bornholdt, ZA, He, S, Herbert, AS, Goodwin, E, et al. Development of a human antibody cocktail that deploys multiple functions to confer pan-Ebolavirus protection. *Cell Host Microbe.* 2019;25(1):39-48.e35. DOI: https://www.sciencedirect.com/science/article/pii/S1931312818306310?via%3Dihub
114. West, BR, Wec, AZ, Moyer, CL, Fusco, ML, Ilinykh, PA, et al. Structural basis of broad ebolavirus neutralization by a human survivor antibody. *Nat Struct Mol Biol.* 2019;26(3):204-212. DOI: https://www.nature.com/articles/s41594-019-0191-4
115. Wiley, MR, Fakoli, L, Letizia, AG, Welch, SR, Ladner, JT, et al. Lassa virus circulating in Liberia: a retrospective genomic characterisation. *Lancet Infect Dis.* 2019;19(12):1371-1378. DOI: https://www.sciencedirect.com/science/article/abs/pii/S1473309919304864?via%3Dihub
116. Williams, MS, Baker, MR, Guina, T, Hewitt, JA, Lanning, L, et al. Retrospective analysis of pneumonic tularemia in Operation Whitecoat human subjects: disease progression and tetracycline efficacy. *Front Med (Lausanne).* 2019;6:229. DOI: https://www.frontiersin.org/articles/10.3389/fmed.2019.00229/full
117. Williamson, LE, Flyak, AI, Kose, N, Bombardi, R, Branchizio, A, et al. Early human B cell response to Ebola virus in four U.S. survivors of infection. *J Virol.* 2019;93(8):e01439-18. DOI: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6450119/
118. Yeh, KB, Wood, H, Scullion, M, Russell, JA, Parker, K, Gnade, BT, Jones, AR, Whittier, C, Mereish, K. Molecular detection of biological agents in the field: then and now. *mSphere.* 2019;4(6):e00695-19. DOI: https://msphere.asm.org/content/4/6/e00695-19
119. Zabetakis, D, Shriver-Lake, LC, Olson, MA, Goldman, ER, Anderson, GP. Experimental evaluation of single-domain antibodies predicted by molecular dynamics simulations to have elevated thermal stability. *Protein Sci.* 2019;28(10):1909-1912. DOI: https://onlinelibrary.wiley.com/doi/full/10.1002/pro.3692

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

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[*] Including viruses and prions.

Objectives: USAMRIID develops medical countermeasures, including candidate vaccines, diagnostic tests and drug or immunological therapies for biological agents, and performs exploratory studies and advanced development of protective and therapeutic countermeasures and agent identification technologies. Additional information is available at http://www.usamriid.army.mil/.

Agents Microorganisms and/or Toxins: Select Agents and Toxins (HHS and Overlap Select Agents, NIAID Category A pathogens, and HHS Select Toxins)

Outdoor Studies: None

National biological defence research and development programmes: Facilities

1. What is the name of the facility?

Argonne National Laboratory (ANL). Argonne National Laboratory initiated a biological defense research and development project in 2019 that requires a BSL-2 laboratory.

2. Where is it located (provide both address and geographical location)?

9700 South Cass Ave., Lemont, IL 60439
(Located 41 km southwest of Chicago, Illinois)

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	28 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	28 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	5

(ii) Division of personnel:

Military	0
Civilian	5

(iii) Division of personnel by category:

Scientists	5
Engineers	0
Technicians	0
Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff:

Biotechnology

(v) Are contractor staff working in the facility? If so, provide an approximate number:

No

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?

Internal: Laboratory Directed Research and Development (LDRD)

(vii) What are the funding levels for the following program areas:

Research	$97,000
Development	$0
Test and evaluation	$0
Total	$97,000

(viii) Briefly describe the publication policy of the facility:

As a Department of Energy facility, ANL is required to make scientific and technical information broadly available, within applicable laws and Departmental requirements, to accomplish mission objectives and strategic goals, promote scientific advancement, satisfy statutory dissemination requirements, and ensure a fair return on Departmental and taxpayer investment. ANL has a mandate to ensure that scientific and technical information is identified, processed, disseminated, and preserved to enable the scientific community and the public to locate and use the unclassified and unlimited-distribution information resulting from DOE research and related endeavors. ANL also has procedures in place to manage and protect classified, sensitive controlled unclassified, and export-controlled scientific and technical information, yet make it accessible for appropriate access by the Department, its contractors, and others. Reviews are conducted prior to publication to determine availability of information, or restrictions thereto. These reviews include, but are not limited to, the following: 1) classification/declassification, 2) copyrighted materials or other intellectual property, 3) export controls or distribution restrictions, and 4) sensitive content that limits access. [US Department of Energy, Scientific and Technical Information Management: https://www.directives.doe.gov/directives/0241.1-BOrder-b/view]

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

None

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

***Objectives*:** The biological defense research conducted at Argonne National Laboratory includes research on printed biosensors aims to rapid prototype highly sensitive, multiplexed, label-free biosensors that can effectively detect and persistently monitor toxic and biological weapon (CBW) agents.

***Microorganisms and/or toxins studied*:** None

***Outdoor Studies*:** None

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Lawrence Livermore National Laboratory (LLNL)

2. Where is it located (provide both address and geographical location)?
7000 East Avenue, Livermore, California 94550
(Located 62 km east-southeast of San Francisco, California)

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	1,822.5 m^2
BSL-3:	59.5 m^2
BSL-4:	0 m^2
Total laboratory floor area:	1,882 m^2

Note: The decrease in BSL-2 lab space of approximately 10 m^2 from 2018 to 2019 is due to a BSL-2 laboratory undergoing renovation during 2019 and not being used for research as well as refinements made in how space is counted.

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	57
(ii)	**Division of personnel:**	
	Military:	0
	Civilian:	57
(iii)	**Division of personnel by category:**	
	Scientists	19
	Engineers	14
	Technicians	11
	Administrative and support staff	13

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Aerosol Science, Analytical Biochemistry, Analytical Mass Spectrometry, Bacteriology, Biochemistry, Bioinformatics, Biomedical Engineering, Biomedical Science, Biotechnology, Computational Biology, Computer Science, Environmental Science, Epidemiology, Genomics, Immunology, Mass Spectrometry, Microbial Forensics, Microbiology, Molecular Biology, Molecular Diagnostics, Nanotechnology, Proteomics, Toxinology, Virology.

(v) Are contractor staff working in the facility? If so, provide an approximate number:
No

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Defense (DoD) – Partly
U.S. Department of Energy (DOE)
U.S. Department of Homeland Security (DHS)
Internal (Laboratory Directed Research and Development)

(vii) What are the funding levels for the following program areas:

Research	$ 1,966,000
Development	$ 1,640,000
Test and evaluation	$ 483,000
Total	$ 4,089,000

(viii) Briefly describe the publication policy of the facility:
As a Department of Energy facility, LLNL is required to make scientific and technical information broadly available, within applicable laws and Departmental requirements, to accomplish mission objectives and strategic goals, promote scientific advancement, satisfy statutory dissemination requirements, and ensure a fair return on Departmental and taxpayer investment. LLNL has a mandate to ensure that scientific and technical information is identified, processed, disseminated, and preserved to enable the scientific community and the public to locate and use the unclassified and unlimited-distribution information resulting from DOE research and related endeavors. LLNL also has procedures in place to manage and protect classified, sensitive controlled unclassified, and export-controlled scientific and technical information, yet make it accessible for appropriate access by the Department, its contractors, and others. Reviews are conducted prior to publication to determine availability of information, or restrictions thereto. These reviews include, but are not limited to, the following: 1) classification/declassification, 2) copyrighted materials or other intellectual property, 3) export controls or distribution restrictions, and 4) sensitive content that limits access. [US Department of Energy, Scientific and Technical Information Management: https://www.directives.doe.gov/directives/0241.1-BOrder-b/view]

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Kane SR, Shah SR, Alfaro TM. Development of a rapid viability polymerase chain reaction method for detection of *Yersinia pestis*. Journal of Microbiological Methods. 2019. 162, July 2019, Pages 21-27. https://doi.org/10.1016/j.mimet.2019.05.005
2. Kane SR, Sanjiv R. Shah SR, Alfaro TM. Rapid viability polymerase chain reaction method for detection of *Francisella tularensis*. Journal of Microbiological Methods. 2019. https://doi.org/10.1016/j.mimet.2019.105738
3. Martin E, Borucki M, Thissen J, et al. Mosquito-Borne Viruses and Insect-Specific Viruses Revealed in Field-Collected Mosquitoes by a Monitoring Tool Adapted from a Microbial Detection Array. Appl Environ Microbiol 2019 Oct 17;85(19). Epub 2019 Sep 17. doi: 10.1128/AEM.0120219. https://www.ncbi.nlm.nih.gov/pubmed/31350319
4. Prentice KW, DePalma L, Ramage JG, et al. Comprehensive Laboratory Evaluation of a Lateral Flow Assay for the Detection of *Yersinia pestis*. Health Security. 2019; 17(6)439-453. DOI: 10.1089/hs.2019.0094l. https://www.liebertpub.com/doi/pdf/10.1089/hs.2019.0094

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

Objectives: The biological defense research conducted at Lawrence Livermore National Laboratory includes biological agent detection, therapeutics and prophylactics development, bioinformatics, virulence mechanism elucidation, structural characterization, agent viability testing, response planning, assay development for monitoring for biological decontamination/response as well as microbial forensic

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[*] Including viruses and prions.

assay development to help determine geographic origin and attribution. LLNL also works to develop diagnostic platforms that use a variety of techniques, such as polymerase chain reaction (PCR), immunoassay, microarray, mass spectrometry and genomic sequencing used to gather useful information about the species present in the sampling environment. Beyond detection, response, recovery, and attribution, LLNL also has ongoing research projects to elucidate mechanisms of host-pathogen interactions. Additional information is available at https://st.llnl.gov/.

***Microorganisms and/or Toxins Studied*:** Select Agents (HHS, Overlap), NIAID Category A pathogens, HHS Select Toxins.

***Outdoor Studies*:** None.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Los Alamos National Laboratory (LANL)

2. Where is it located (provide both address and geographical location)?
Bikini Atoll Road, SM-30, Los Alamos, NM 87545
(Located approximately 72 km west of Santa Fe, New Mexico)

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	533.2 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	533.2 m^2

Note: Due to increased project scope in 2019, the BSL-2 laboratory space used for biodefense research and development was expanded from 354 to 533.2 m^2. A portion of the reported BSL-2 laboratory space (37.2 m^2) was physically remodeled.

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	23
(ii)	**Division of personnel:**	
	Military	0
	Civilian	23
(iii)	**Division of personnel by category:**	
	Scientists	15
	Engineers	0
	Technicians	8
	Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Analytical Biochemistry, Bacteriology, Bioinformatics, Biomedical Science, Biological Science, Biomedical Engineering, Cell Biology, Environmental Science, Genetics, Genomics, Microbiology, Microscopy, Molecular Biology, Biomedical Science, Medicine, Toxicology, Virology.

(v) Are contractor staff working in the facility? If so, provide an approximate number:
No

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Defense (DoD) – Partly
U.S. Department of Energy (DOE)
U.S. Department of Health & Human Services (HHS)
Internal (Laboratory Directed Research and Development)
Other Government Agencies

(vii) What are the funding levels for the following program areas:

Research	$2,788,000
Development	$895,000
Test and evaluation	$0
Total	$3,683,000

(viii) Briefly describe the publication policy of the facility:

As a Department of Energy facility, LANL is required to make scientific and technical information broadly available, within applicable laws and Departmental requirements, to accomplish mission objectives and strategic goals, promote scientific advancement, satisfy statutory dissemination requirements, and ensure a fair return on Departmental and taxpayer investment. LANL has a mandate to ensure that scientific and technical information is identified, processed, disseminated, and preserved to enable the scientific community and the public to locate and use the unclassified and unlimited-distribution information resulting from DOE research and related endeavors. LANL also has procedures in place to manage and protect classified, sensitive controlled unclassified, and export-controlled scientific and technical information, yet make it accessible for appropriate access by the Department, its contractors, and others. Reviews are conducted prior to publication to determine availability of information, or restrictions thereto. These reviews include, but are not limited to, the following: 1) classification/declassification, 2) copyrighted materials or other intellectual property, 3) export controls or distribution restrictions, and 4) sensitive content that limits access. [US Department of Energy, Scientific and Technical Information Management: https://www.directives.doe.gov/directives/0241.1-BOrder-b/view]

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Ross B, Micheva-Viteva S, Hong-Geller E, and Torres A. Evaluating the role of *Burkholderia pseudomallei* K96243 toxins BPSS0390, BPSS0395, and BPSS1584 in persistent infection. Cellular Microbiology. 2019 Aug 10; https://doi.org/10.1111/cmi.13096
2. Kalb D, Adikari S, Hong-Geller E, and Werner JH. Single cell correlations of mRNA and protein content in human monocytic cell line after LPS stimulation. 2019 Apr 19; PLoS One 14(4): e0215602. https://doi.org/10.1371/journal.pone.0215602
3. Arzt J, Fish I, Pauszek SJ, et al. The evolution of a super-swarm of *Foot-and-mouth disease virus* in cattle. PLoS One. 2019 Apr 25; 14(4) e0210847. https://doi.org/10.1371/journal.pone.0210847.
4. Hovde BT, Daligault HE, Hanschen ER, et al. Detection of Abrin-Like and Prepropulchellin-Like Toxin Genes and Transcripts Using Whole Genome Sequencing and Full-Length Transcript Sequencing of *Abrus precatorius*. Toxins. 2019 Oct 10; 11(12):691. https://doi.org/10.3390/toxins11120691

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms* and/or toxins studied, as well as outdoor studies of biological aerosols:

***Objectives*:** The biological defense research and development activities at the Los Alamos National Laboratory include pathogen characterization, host-pathogen interaction studies, pathogen detection, integrative biosurveillance and analysis technology development. The main objectives for the studies are to: understand molecular mechanisms of host-pathogen interaction; study molecular, chemical, and physical characteristics of biothreat agents, including bacteria, viruses and toxins, for detection, characterization, assay design and improvement; evaluate detection assay and platform performance; assess commercial techniques for pathogen detection and biosurveillance on environmental monitoring procedures; develop DNA, RNA and protein based bioforensics assays; develop next generation high throughput microbial sequencing, finishing and analysis capabilities; perform viral and bacterial pathogen sequencing for characterization, comparative genomic analysis, and metagenomic analysis; develop high throughput assays for host-pathogen protein interactions screening; develop and validate assays to improve the ability to identify and characterize bioterrorism incident; study antibiotic potentials of radioisotopes; and identify host molecular targets as potential therapeutic candidates. Additional information is available at https://www.lanl.gov/org/ddste/aldcels/bioscience/biosecurity-public-health/index.php.

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* Including viruses and prions.

***Microorganisms and/or Toxins Studied*:** Simulant, Overlap Select Agent and HHS Select Toxin.

***Outdoor Studies*:** None.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Pacific Northwest National Laboratory (PNNL)

2. Where is it located (provide both address and geographical location)?
Personnel and budget were shared between two PNNL campuses in 2019:

Richland Campus: 902 Battelle Boulevard, Richland, Washington 99352.
(Located 235 km southwest from Spokane, WA and 327 km southeast from Seattle, WA.)

Sequim campus: 1529 West Sequim Bay Road, Sequim, Washington 98382.
(Located 489 km northwest from the PNNL Richland, WA campus and 106 km west from Seattle, WA.)

3. Floor area of laboratory areas by containment level (m^2):

Richland campus:

BSL-2:	1470 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	1470 m^2

Sequim campus:

BSL-2:	109 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	109 m^2

Note: Due to increased project scope in 2019, the BSL-2 laboratory space used for biodefense research and development was expanded from 1252 to 1470 m^2. The BSL-2 laboratory space was not physically remodeled.

4. The organizational structure of each facility:

(i) Total number of personnel: 127
Richland & Sequim campuses (shared personnel)

(ii) Division of personnel:

Military	0
Civilian	127

(iii) Division of personnel by category:

Scientists	110
Engineers	1
Technicians	0
Admin and Support Staff	16

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Analytical Mass Spectrometry, Bacteriology, Biochemistry, Biological Science, Cell Biology, Chemistry, Computational Biology, Genetics, Genomics, Mass Spectrometry, Microbial Forensics, Microbiology,

Molecular Biology, Nanotechnology, Pathology, Proteomics, Structural Biology, Systems Biology, Virology.

(v) Are contractor staff working in the facility? If so, provide an approximate number:

Yes	Number: 1

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?

U.S. Department of Defense (DoD) - Partly
U.S. Department of Energy (DOE)
U.S. Department of Homeland Security (DHS)
U.S. Department of State (DOS)
U.S. Department of Health and Human Services (HHS)
Internal (Laboratory Directed Research and Development)
Other Government Agencies

(vii) What are the funding levels for the following program areas:

Research	$10,802,512
Development	$659,064
Test and evaluation	$990,458
Total	$12,452,034

(viii) Briefly describe the publication policy of the facility:

As a Department of Energy facility, PNNL is required to make scientific and technical information broadly available, within applicable laws and Departmental requirements, to accomplish mission objectives and strategic goals, promote scientific advancement, satisfy statutory dissemination requirements, and ensure a fair return on Departmental and taxpayer investment. PNNL has a mandate to ensure that scientific and technical information is identified, processed, disseminated, and preserved to enable the scientific community and the public to locate and use the unclassified and unlimited-distribution information resulting from DOE research and related endeavors. PNNL also has procedures in place to manage and protect classified, controlled unclassified, and export-controlled scientific and technical information, yet make it accessible for appropriate access by the Department, its contractors, and others. Reviews are conducted prior to publication to determine availability of information, or restrictions thereto. These reviews include, but are not limited to, the following: 1) classification/declassification, 2) copyrighted materials or other intellectual property, 3) export controls or distribution restrictions, and 4) sensitive content that limits access. [US Department of Energy, Scientific and Technical Information Management: https://www.directives.doe.gov/directives/0241.1-BOrder-b/view] For this location, a searchable database of materials published since 1988 is available at http://www.pnnl.gov/publications/.

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Hutchison JR, Brooks SM, Kennedy ZC, et al. Polysaccharide-based liquid storage and transport media for non-refrigerated preservation of bacterial pathogens. PLoS One. 2019 Sept 6; 14(9): e0221831. https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0221831
2. Hutchison JR, Widder MW, Brooks SM, et al. Consistent Production of Chlorine-Stressed Bacteria from Non-Chlorinated Secondary Sewage Effluents for use in the US Environmental Protection Agency Alternate Test Procedure Protocol. Journal of Microbiological Methods. 2019 June 7; 163 (2019) 105651. https://www.sciencedirect.com/science/article/pii/S016770121930377X?via%3Dihub

3. Cosimbescu L, Malhotra D, Campbell KB, Swita MS, and Kennedy ZC. Molecular Design and Shear Stability Correlations of Dendritic Polymethacrylates. Molecular Systems Design and Engineering. 2019 Oct 2; 4, 1114-1124. https://pubs.rsc.org/en/content/articlehtml/2019/me/c9me00081j
4. Merkley ED, Burnum-Johnson KE, Anderson LN, Jenson SC, and KL Wahl. Uniformly 15N-Labeled Recombinant Ricin A-chain as an Internal Retention Time Standard for Increased Confidence in Forensic Identification of Ricin by Untargeted Nanoflow Liquid Chromatography-Tandem Mass Spectrometry. Analytical Chemistry. 2019 Oct 9; 91, 13372-13376. https://pubs.acs.org/doi/full/10.1021/acs.analchem.9b03389#
5. O'Bryon I, Tucker AE, Kaiser B, Wahl KL, and Merkley ED. Constructing a Tandem Mass Spectral Library for Forensic Ricin Identification. Journal of Proteome Research. 2019 Sept 30; 18, 3926-3935. https://pubs.acs.org/doi/pdf/10.1021/acs.jproteome.9b00377
6. Heller NC, Garrett AM, Merkley ED, et al. Probabilistic Limit of Detection for Ricin Identification Using a Shotgun Proteomics Assay. Analytical Chemistry. 2019 Sept 6; 91, 12399-12406. https://pubs.acs.org/doi/full/10.1021/acs.analchem.9b02721
7. McClure RS, Wendler JP, Adkins JN, et al. Waters KM, and McDermott JE. Unified Feature Association Networks through Integration of Transcriptomic and Proteomic Data. PLoS Computational Biology. 2019 Sept 17; no 15 9:e1007241. https://journals.plos.org/ploscompbiol/article?id=10.1371/journal.pcbi.1007241
8. McDermott JE, Cort JR, Nakayasu ES, et al. Prediction of Bacterial E3 Ubiquitin Ligase Effectors using Reduced Amino Acid Peptide Fingerprinting. PeerJ. 2019 June 7. https://peerj.com/preprints/27292/
9. Couvillion SP, Zhu Y, Nagy G, et al. New mass spectrometry technologies contributing towards comprehensive and high throughput omics analyses of single cells. Analyst. 2019 January 28; 144 no 3:794-807. https://www.ncbi.nlm.nih.gov/pubmed/30507980
10. Kyle JE, Burnum-Johnson KE, Wendler JP, et al. Plasma lipidome reveals critical illness and recovery from human Ebola virus disease. Proceedings of the National Academy of Sciences of the United States of America. 2019 February 26; 116, no 9:3919-3928. https://www.pnas.org/content/116/9/3919
11. Mitchell HD, Eisfeld AJ, Stratton KG, et al. The Role of EGFR in Influenza Pathogenicity: Multiple Network-based Approaches to Identify a Key Regulator of Non-Lethal Infections. Frontiers in Cell and Developmental Biology. 2019 September 20; https://www.frontiersin.org/articles/10.3389/fcell.2019.00200/full
12. Burnum-Johnson KE, Zheng X, Dodds JN, et al. Ion mobility spectrometry and the omics: Distinguishing isomers, molecular classes and contaminant ions in complex samples. Trends in Analytical Chemistry. 2019 July 1; TrAC 116 (2019) 292-299. https://www.sciencedirect.com/science/article/pii/S0165993619300056

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

***Objectives*:** PNNL is involved in biodefense-related activities including agent characterization (e.g., knock out experiments and investigation of infectious properties of agents) and the development of detection methods (e.g., nucleic acid, toxin, and proteomic signatures); testing and evaluation of commercial off the shelf equipment for agent detection as well as investigation of next generation biodetection equipment; biological and chemical forensics; investigation of natural history of agents; pathogenesis studies; and interrogating DNA sequencing data and related analysis tools. No outdoor studies of biological aerosols were conducted.

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[*] Including viruses and prions.

***Microorganisms and/or toxins studied*:** Simulants, HHS Select Toxins.

***Outdoor Studies*:** None

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Sandia National Laboratories (SNL)

2. Where is it located (provide both address and geographical location)?
Personnel and budget were shared between two SNL campuses in 2019:

New Mexico Campus: P. O. Box 5800, Albuquerque, NM 87185
(Located on Kirtland Air Force Base, in southeastern Albuquerque)

California Campus: 7011 East Avenue, Livermore, California
(Located in Livermore, CA.)

3. Floor area of laboratory areas by containment level (m^2):

New Mexico campus:

BSL-2:	1152.45 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	1152.45 m^2

California campus:

BSL-2:	230 m^2
BSL-3:	0 m^2
BSL-4:	0 m^2
Total laboratory floor area:	230 m^2

Note: Due to changes in project scope in 2019, the BSL-2 laboratory space used for biodefense research and development was decreased from 1268.49 to 1152.45 m^2. The BSL-2 laboratory space was not physically remodeled.

4. The organizational structure of each facility:

(i) Total number of personnel:

New Mexico campus:	256
California campus:	101

(ii) Division of personnel:

Military	0
Civilian	357

(iii) Division of personnel by category:

Scientists	107
Engineers	81
Technicians	145
Admin and Support Staff	24

(iv) List the scientific disciplines represented in the scientific/engineering staff:

Aerobiology, Aerosol Science, Analytical Biochemistry, Analytical Chemistry, Analytical Mass Spectrometry, Bacteriology, Biochemistry, Bioinformatics, Bioinorganic Chemistry, Biological Science, Biomedical Engineering, Biomedical Science, Biophysics, Biotechnology, Cell Biology, Chemical Engineering, Chemistry, Computational Biology, Computer Engineering, Computer Science, Electrical Engineering, Environmental Engineering, Environmental Science, Genetics, Genomics, Immunology, Mass Spectrometry, Materials Science, Mathematics, Mechanical Engineering, Medicine, Microbial Forensics, Microbiology, Molecular Biology, Molecular Diagnostics, Nanotechnology, Neuroscience, Operations Research Analysis, Optical Spectroscopy, Pathology, Physics, Physiology, Polymer Science, Protein Engineering, Proteomics, Structural Biology, Toxicology, Virology.

(v) Are Contractor staff working in the facility?
No

(vi) What is (are) the source(s) of funding for the work conducted in the facility?
U.S. Department of Defense (DoD) - Partly
U.S. Department of Health and Human Services (HHS)
Internal (Laboratory Directed Research & Development)
Academia
Private sector

(vii) What are the funding levels for Research and Development and Testing and Evaluation as of the most recent calendar year?

Research	$ 9,164,000
Development	$ 4,131,000
Test and Evaluation	$ 30,000
Total	$ 13,325,000

(viii) Briefly describe the publication policy of the facility:
As a Department of Energy (DOE) facility, Sandia National Laboratories (SNL) is required to make scientific and technical information broadly available, within applicable laws and Departmental requirements, to accomplish mission objectives and strategic goals, promote scientific advancement, satisfy statutory dissemination requirements, and ensure a fair return on Departmental and taxpayer investment. SNL has a mandate to ensure that scientific and technical information is identified, processed, disseminated, and preserved to enable the scientific community and the public to locate and use the unclassified and unlimited-distribution information resulting from DOE research and related endeavors. SNL also has procedures in place to manage and protect classified, sensitive controlled unclassified, and export-controlled scientific and technical information, yet make it accessible for appropriate access by the Department, its contractors, and others. Reviews are conducted prior to publication to determine availability of information, or restrictions thereto. These reviews include, but are not limited to, the following: 1) classification/declassification, 2) copyrighted materials or other intellectual property, 3) export controls or distribution restrictions, and 4) sensitive content that limits access. [Department of Energy, Scientific and Technical Information Management: https://www.directives.doe.gov/directives/0241.1-BOrder-b/view]

(ix) Provide a list of publicly available papers and reports resulting from work during the previous 12 months:

1. Arévalo, M. T., Rizzo, G. M., Polsky, R., et al. Proteomic Characterization of Immunoglobulin Content in Dermal Interstitial Fluid. Journal of Proteome Research. 2019. 10.1021/acs.jproteome.9b00155. https://www.scopus.com/inward/record.uri?eid=2-s2.0-

85066951489&doi=10.1021%2facs.jproteome.9b00155&partnerID=40&md5=dea03d317b72a65780dc3a2ff549302a

2. Caratenuto, R. A., III, Ciabattoni, G. O., DesGranges, et al. Genome sequences of six cluster n mycobacteriophages, kevin1, nenae, parmesanjohn, shrimpfriedegg, smurph, and spongebob, isolated on *Mycobacterium smegmatis* mc2155. Microbiology Resource Announcements. 2019. 10.1128/MRA.00399-19. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067256661&doi=10.1128%2fMRA.00399-19&partnerID=40&md5=a97c0c4cfabf96a819783bd831e71237
3. Caswell, J., Gans, J. D., Generous, N., Hudson, et al. Defending Our Public Biological Databases as a Global Critical Infrastructure. Frontiers in Bioengineering and Biotechnology. 2019. 10.3389/fbioe.2019.00058. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6460893/
4. Chen, Y., Guenther, J. M., Gin, J. W., et al. Automated "cells-To-Peptides" Sample Preparation Workflow for High-Throughput, Quantitative Proteomic Assays of Microbes. Journal of Proteome Research. 2019. 10.1021/acs.jproteome.9b00455. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85072633124&doi=10.1021%2facs.jproteome.9b00455&partnerID=40&md5=c313858df5766a188e2b2b7603223b6c
5. Jacquet, R., LaBauve, A. E., Akoolo, L., et al. Dual gene expression analysis identifies factors associated with *Staphylococcus aureus* virulence in diabetic mice. Infection and Immunity. 2019. 10.1128/IAI.00163-19. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85065047169&doi=10.1128%2fIAI.00163-19&partnerID=40&md5=2609cd53c4b1c79aefdbefd7d9d301f5
6. Johnston, R. K., Seamon, K. J., Saada, E. A., et al. Use of anti-CRISPR protein AcrIIA4 as a capture ligand for CRISPR/Cas9 detection. Biosensors and Bioelectronics. 2019. 10.1016/j.bios.2019.111361. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85067174275&doi=10.1016%2fj.bios.2019.111361&partnerID=40&md5=2e9d1cae8c399700ede894ed5d4c857d
7. Kinahan, Sean M., Tezak, Matthew S., Siegrist, Cathryn M., et al. Changes of fluorescence spectra and viability from aging aerosolized *E. coli* cells under various laboratory-controlled conditions in an advanced rotating drum. Aerosol Science and Technology. 2019. 10.1080/02786826.2019.1653446. http://dx.doi.org/10.1080/02786826.2019.1653446
8. Lacey, Randy F., Ye, Dongmei and Ruffing, Anne M. Engineering and characterization of copper and gold sensors in *Escherichia coli* and Synechococcus sp. PCC 7002. Applied Microbiology and Biotechnology. 2019. 10.1007/s00253-018-9490-7. http://dx.doi.org/10.1007/s00253-018-9490-7
9. Leynaud-Kieffer, L. M. C., Curran, S. C., Kim, I., et al. A new approach to Cas9-based genome editing in *Aspergillus niger* that is precise, efficient and selectable. PLoS ONE. 2019. 10.1371/journal.pone.0210243. https://www.scopus.com/inward/record.uri?eid=2-s2.0-85060164730&doi=10.1371%2fjournal.pone.0210243&partnerID=40&md5=500f11ab47ebc345c349fbe314e62854
10. Olden, B. R., Perez, C. R., Wilson, A. L., et al. Cell-Templated Silica Microparticles with Supported Lipid Bilayers as Artificial Antigen-Presenting Cells for T Cell Activation. Advanced Healthcare Materials. 2019. 10.1002/adhm.201801188. https://onlinelibrary.wiley.com/doi/full/10.1002/adhm.201801188
11. Phaneuf, Christopher R., Seamon, Kyle J., Eckles, Tyler P., et al. Ultrasensitive multi-species detection of CRISPR-Cas9 by a portable centrifugal microfluidic platform. Analytical Methods. 2019. 10.1039/c8ay02726a. http://dx.doi.org/10.1039/c8ay02726a
12. Sava Gallis, Dorina F., Butler, Kimberly S., Agola, Jacob O., et al. Antibacterial Countermeasures via Metal-Organic Framework-Supported Sustained Therapeutic Release Journal: ACS Applied Materials and Interfaces. 2019. 10.1021/acsami.8b21698. http://dx.doi.org/10.1021/acsami.8b21698

5. Briefly describe the biological defense work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: To improve the United States' ability to anticipate and defend against biological threats, SNL's multidisciplinary research team applies its traditional strengths in engineering and technology development to achieve the following goals: 1) gain basic knowledge regarding the fundamental molecular processes of pathogenesis, including the dynamic interactions between microbial pathogens and their hosts; 2) develop assays, novel materials, and platforms to detect and diagnose traditional and unknown pathogens, as well as to discover novel therapeutic targets; and 3) obtain an understanding of the microbiome's effects on human health in the absence or in the presence of an infectious disease.

***Microorganisms and/or toxins studied*:** None

***Outdoor studies*:** None

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[*] Including viruses and prions.

National biological defence research and development programmes

1. What is the name of the facility?
Centers for Disease Control and Prevention (CDC), National Center for Environmental Health (NCEH), Division of Laboratory Services (DLS)

2. Where is it located (include both address and geographical location)?
4770 Buford Highway, Atlanta, Georgia 30341

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	568 m^2
BSL-3	0 m^2
BSL-4	0m^2
Total laboratory floor area	568 m^2

4. The organizational structure of each facility.

(i)	**Total number of personnel**	18
(ii)	**Division of personnel**:	
	Military	0
	Civilian	18
(iii)	**Division of personnel by category**:	
	Scientists	18
	Engineers	0
	Technicians	0
	Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff.
Analytical Biochemistry, Analytical Chemistry, Analytical Mass Spectrometry, Biochemistry, Biology, Chemistry, Mass Spectrometry, Proteomics

(v) Are contractor staff working in the facility? If so, provide an approximate number.

Yes	Number: 5

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
Centers for Disease Control and Prevention, Department of Health and Human Services (HHS)

(vii) What are the funding levels for the following programme areas:

Research	$2,034,629.73
Development	$998,180.00
Test and evaluation	$2,215,920.05
Total	$5,248,729.78

(viii) Briefly describe the publication policy of the facility:
Scientists are encouraged to publish their results in the peer reviewed scientific literature as well as present their work at national and international professional meetings. The clearance

policy for information products disseminated outside CDC for public use is available online at: http://www.cdc.gov/od/science/policies. CDC also has an internal policy on "Oversight and clearance of dual use research of concern."

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Horowitz BZ, Castelli R, Hughes A, Hendrickson RG, Johnson RC, Thomas JD. Massive fatal overdose of abrin with progressive encephalopathy [published online ahead of print, 2019 Aug 28]. Clin Toxicol (Phila). 2019;1–4. doi:10.1080/15563650.2019.1655150 https://www.tandfonline.com/doi/full/10.1080/15563650.2019.1655150
2. Kalb SR, Baudys J, Kiernan K, Wang D, Becher F, and Barr JR. Proposed BoNT/A and /B Peptide Substrates Cannot Detect Multiple Subtypes in the Endopep-MS Assay [published online ahead of print, 2019 Jul 9]. J Anal Toxicol. https://academic.oup.com/jat/advance-article-abstract/doi/10.1093/jat/bkz044/5530128?redirectedFrom=fulltext
3. Lins RC, Boyer AE, Kuklenyik Z, Woolfitt AR, Goldstein J, Hoffmaster AR, et al. Zeptomole per milliliter detection and quantification of edema factor in plasma by LC-MS/MS yields insights into toxemia and the progression of inhalation anthrax. Anal. Bioanal. Chem. 2019, May; 411(12):2493-2509. https://link.springer.com/article/10.1007%2Fs00216-019-01730-4
4. Solano MI, Woolfitt AR, Boyer AE, Lins RC, Isbell K, Gallegos-Candela M et al. Accurate and selective quantification of anthrax protective antigen in plasma by immunocapture and isotope dilution mass spectrometry. Analyst, 2019, Mar 25; 144(7):2264-2274. https://pubs.rsc.org/en/content/articlelanding/2019/AN/C8AN02479K#!divAbstract
5. Wang D, Baudys J, Hoyt K, Barr JR, and Kalb SR. Sensitive Detection of Type G Botulinum Neurotoxin through Endopep-MS Peptide Substrate Optimization. Anal. Bioanal.Chem. 2019 Aug; 411(21): 5489-5497. https://link.springer.com/article/10.1007%2Fs00216-019-01926-8
6. Wharton RE, Cunningham BR, Schaefer AM, Guldberg SM, Hamelin EI, Johnson RC. Measurement of Microcystin and Nodularin Activity in Human Urine by Immunocapture-Protein Phosphatase 2A Assay. Toxins (Basel). 2019 Dec 13; 11(12):729. doi:10.3390/toxins11120729 https://www.scilit.net/article/4a9eca0b1a8fc150a34d676fa695d013?action=show-references

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: The Division of Laboratory Sciences develops methods for measuring selected toxins to help improve detection and diagnosis during a public health response to biological toxins.

Agents Microorganisms and/or toxins studied: Select Agents (HHS), Select Toxins (HHS), NIAID Category A Pathogens

Outdoor studies: Outdoor studies of biological aerosols were not conducted at the facility or off-site by facility personnel.

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[*] Including viruses and prions.

National biological defence research and development programmes

1. What is the name of the facility?

Centers for Disease Control and Prevention (CDC), Deputy Director for Infectious Diseases (DDID)

2. Where is it located (include both address and geographical location)?

1600 Clifton Road N.E., Atlanta, Georgia 30329

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	423 m^2
BSL-3	1220 m^2
BSL-4	533 m^2
Total laboratory floor area	2176 m^2

4. The organizational structure of each facility.

(ii)	**Total number of personnel:**	222

(ii) Division of personnel:

Military	6
Civilian	216

(iii) Division of personnel by category:

Scientists	186
Engineers	0
Technicians	17
Administrative and support staff	19

(iv) List the scientific disciplines represented in the scientific/engineering staff.

Animal Science, Biochemistry, Bioinformatics, Biology, Biological Science, Cell Biology. Chemistry, Clinical Immunology, Ecology, Entomology, Epidemiology, Genetics, Genomics, Immunology, Medicine, Microbiology, Molecular Biology, Molecular Diagnostics, Public Health, Statistics, Veterinary Medicine, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number.

Yes Number: 45

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?

U.S. Department of Health and Human Services (HHS)
U.S. Department of Homeland Security (DHS)
U.S. Department of Defense (DoD) - Partly
U.S. Agency for International Development (USAID)

(vii) What are the funding levels for the following programme areas:

Research	$14,205,315
Development	$5,785,469
Test and evaluation	$8,495,700
Total	$28,486,484

(viii) Briefly describe the publication policy of the facility:
Publication is encouraged and managed by editorial and clearance policies conducted at all levels of the Agency. The clearance policy for information products disseminated outside CDC for public use is available online at: http://www.cdc.gov/od/science/policies. CDC also has an internal policy on "Oversight and clearance of dual use research of concern."

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Ganapathiraju PV, Gharpure R, Thomas D, Millet N, Gurrieri D, Chatham Stephens K et al. Notes from the Field: Botulism Type E After Consumption of Salt-Cured Fish - New Jersey, 2018. MMWR. 2019 Nov 8; 68(44):1008-1009. doi: 10.15585/mmwr.mm6844a3. https://www.ncbi.nlm.nih.gov/pubmed/31697653
2. Halpin JL, Dykes JK, Katz L, Centurioni DA, Perry MJ, Egan CT, Lúquez C. Molecular Characterization of Clostridium botulinum Harboring the bont/B7 Gene. Foodborne Pathog Dis. 2019 Jun; 16(6):428-433. doi: 10.1089/fpd.2018.2600. Epub 2019 Mar 30. https://www.ncbi.nlm.nih.gov/pubmed/30932710
3. Bergeron G, Latash J, Da Costa-Carter CA, Egan C, Stavinsky F, Kileci JA et al. Notes from the Field: Botulism Outbreak Associated with Home-Canned Peas - New York City, 2018. MMWR. 2019 Mar 15; 68(10):251-252. doi: 10.15585/mmwr.mm6810a5. https://www.ncbi.nlm.nih.gov/pubmed/30870408
4. Halpin JL, Wangroongsarb P, Jittaprasartsin C, Dykes JK, Lúquez C. Draft Genome Sequence of a Clostridium botulinum Isolate from Thailand Harboring the Subtype bont/B8 Gene. Microbiol Resour Announc. 2019 Jan 31; 8(5). pii: e01216-18. doi: 10.1128/MRA.01216-18. https://www.ncbi.nlm.nih.gov/pubmed/30714030
5. Halpin JL, Dykes JK, Lúquez C. Draft Genome Sequences for Dual-Toxin-Producing Clostridium botulinum Strains. Microbiol Resour Announc. 2019 Jan 24; 8(4). pii: e01152-18. doi: 10.1128/MRA.01152-18.https://www.ncbi.nlm.nih.gov/pubmed/30701230
6. Whitehouse ER. Novel treatment of a Vaccinia virus infection from an occupational needlestick — San Diego, California, 2019. MMWR. 2019; 68:943-6. https://www.cdc.gov/mmwr/volumes/68/wr/mm6842a2.htm?s_cid=mm6842a2_w
7. Weiner ZP, Salzer JS, LeMasters E, et al. Characterization of Monkeypox virus dissemination in the black-tailed prairie dog (Cynomys ludovicianus) through in vivo bioluminescent imaging. PloS One 2019; 14:e0222612. https://doi.org/10.1371/journal.pone. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6762066/
8. Reynolds MG, Wauquier N, Li Y, et al. Human Monkeypox in Sierra Leone after 44-Year Absence of Reported Cases. Emerging Inf Dis. 2019; 25:1023-5. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6478203/
9. Reynolds MG, Doty JB, McCollum AM, Olson VA, Nakazawa Y. Re-emergence of Monkeypox in Africa: a Call to Expand the Concept and Practice of One Health. Expert Reviews in Anti-Infective Therapy. 2019; 17:129-39. DOI: 10.1080/14787210.2019.1567330. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6438170/
10. Merchlinsky M, Albright A, Olson V, et al. The development and approval of tecoviromat (TPOXX®), the first antiviral against smallpox. Antiviral Res. 2019; 168:168-74. https://www.ncbi.nlm.nih.gov/pubmed/?term=The+development+and+approval+of+tecoviromat+(TPOXX%C2%AE)%2C+the+first+antiviral+against+smallpox
11. Lindholm DA, Fisher RD, Montgomery JR, et al. Preemptive tecovirimat use in an active duty member presenting with acute myeloid leukemia after smallpox vaccination. Clin Inf Dis. 2019; 69:2205-7. DOI: 10.1093/cid/ciz286.

https://www.ncbi.nlm.nih.gov/pubmed/?term=Preemptive+tecovirimat+use+in+an+active+duty+member

12. Leung J, McCollum AM, Radford K, et al. Varicella in Tshuapa Province, Democratic Republic of the Congo, 2009-2014. Trop Med Int Health 2019; 24:839-48. doi:10.1111/tmi.13243. https://www.ncbi.nlm.nih.gov/pubmed/?term=Varicella+in+Tshuapa+Province%2C+Democratic+Republic+of+the+Congo%2C+2009-2014
13. Jeon S, Cleaton J, Meltzer MI, et al. Determining the post-elimination level of vaccination needed to prevent re-establishment of dog rabies. PLoS Neglected Tropical Diseases. 2019; 13:e0007869. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6907870/
14. Hutson CL, Gallardo-Romero N, Carroll DS, et al. Analgesia during Experimental Challenge Studies of Monkeypox Virus in Prairie Dogs (Cynomys ludovicianus). J Am Assoc Lab Anim Sci. 2019; 58:1-16. DOI: 0.30802/AALAS-JAALAS-18-000036. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6643093/
15. Guagliardo SAJ, Monroe B, Moundjoa C, et al. Asymptomatic Orthopoxvirus circulation in humans in the wake of a monkeypox outbreak among chimpanzees in Cameroon. AM J trop Med Hyg. 2019: DOI: https://doi.org/10.4269/ajtmh.19-0467 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6947779/
16. Guagliardo SAJ, Doshi RH, Reynolds MG, et al. Do monkeypox exposures vary by ethnicity? Comparison of Aka- and Bantu-suspected monkeypox cases. AM J Trop Med Hyg. 2019: doi:10.4269/ajtmh.19-0457. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6947767/
17. Gigante CM, Gao J, Tang S, et al. Genome of Alaskapox virus, a novel orthopoxvirus isolated from Alaska. Viruses. 2019; 11:708; https://doi.org/10.3390/v11080708. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6723315/
18. Doty JB, Maghlakelidze G, Sikharulidze I, et al. Isolation and characterization of Akhmeta virus from wild-caught rodents (Apodemus spp.) in Georgia. J Virol. 2019; 93:e00966-19. doi: 10.1128/JVI.-19 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6880181/
19. Doshi RH, Guagliardo SAJ, Doty JB, et al. Epidemiologic and Ecologic Investigations of Monkeypox, Likouala Department, Republic of the Congo, 2017. Emerg Infect Dis. 2019; 25:281-9. https://wwwnc.cdc.gov/eid/article/25/2/18-1222_article
20. Angelo KM, Petersen BW, Hamer DH, Schwartz E, Brunette G. Monkeypox transmission among international travellers—serious monkey business? J Travel Med. 2019;1-2. doi: 10.1093/jtm/taz002. https://www.ncbi.nlm.nih.gov/pubmed/?term=Monkeypox+transmission+among+international+travellers+serious+monkey+business
21. Donahue MA, Newcomb G, Spinella S, et al. CNS Melioidosis in a Traveler Returning from Cabo, Mexico. Open Forum Infect Dis. 2019; 6(2):ofz005. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6377934/
22. Hall CM, Jaramillo S, Jimenez R, et al. Burkholderia pseudomallei, the causative agent of melioidosis, is rare but ecologically established and widely dispersed in the environment in Puerto Rico. PLoS Neglected Tropical Diseases. 2019; 13(9):e0007727. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6748447/
23. Nolen LD, Lirow E, Gee JE, Elrod MG, Kolton CB, Liu L et al. Differentiating New from Newly Detected: Melioidosis in Yap, Federated States of Micronesia. Am J Trop Med Hyg. 2019; 101(2):323-327. http://www.ajtmh.org/docserver/fulltext/14761645/101/2/tpmd190253.pdf?expires=1580318212&id=id&accname=11600&checksum=1B9ABCAE8CE1A1A1CCE7D6695A073E80
24. Kolton CB, Marston CK, Stoddard RA, et al. Detection of Bacillus anthracis in animal tissues using InBios active anthrax detect rapid test lateral flow immunoassay. Lett Appl Microbiol. 2019. https://sfamjournals.onlinelibrary.wiley.com/doi/full/10.1111/lam.13134
25. Pillai SP, Prentice KW, Ramage JG, et al. Rapid Presumptive Identification of Bacillus anthracis Isolates Using the Tetracore RedLine Alert Test. Health Security. 2019; 17(4):334-343.

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6708271/

26. Cossaboom CM, Khaiseb S, Haufiku B, et al. Anthrax Epizootic in Wildlife, Bwabwata National Park, Namibia, 2017. Emerg Infect Dis. 2019; 25(5):947-950. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6478215/
27. Gargis AS, Lascols C, McLaughlin HP, Conley AB, Hoffmaster AR, Sue D. Genome Sequences of Penicillin-Resistant Bacillus anthracis Strains. Microbiol Resour Announc. 2019; 8(2). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6328647/
28. Guendel I, Ekpo LL, Hinkle MK, et al. Melioidosis after Hurricanes Irma and Maria, St. Thomas/St. John District, US Virgin Islands, October 2017. Emerg Infect Dis. 2019; 25(10):1952-1955. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6759263/
29. Abudurexiti A, Adkins S, Alioto D, et al. Taxonomy of the order Bunyavirales: update 2019. Arch Virol. 2019;164(7):1949-1965. https://www.ncbi.nlm.nih.gov/pubmed/31065850
24. Amarasinghe GK, Ayllon MA, Bao Y, et al. Taxonomy of the order Mononegavirales: update 2019. Arch Virol. 2019; 164(7):1967-1980. https://www.ncbi.nlm.nih.gov/pubmed/31089958
25. Bruhn JF, Hotard AL, Spiropoulou CF, Lo MK, Saphire EO. A Conserved Basic Patch and Central Kink in the Nipah Virus Phosphoprotein Multimerization Domain Are Essential for Polymerase Function. Structure (London, England: 1993). 2019; 27(4):660-668.e664. https://www.ncbi.nlm.nih.gov/pubmed/?term=Conserved+Basic+Patch+and+Central+Kink+in+the+Nipah+Virus+Phosphoprotein+Multimerization+Domain+Are+Essential+for+Polymerase+Function
26. Davis CW, Jackson KJL, McElroy AK, et al. Longitudinal Analysis of the Human B Cell Response to Ebola Virus Infection. Cell. 2019;177(6):1566-1582.e1517. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6908968/
27. Dzimianski JV, Scholte FEM, Williams IL, et al. Determining the molecular drivers of species-specific interferon-stimulated gene product 15 interactions with nairovirus ovarian tumor domain proteases. PloS One. 2019;14(12): e0226415. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6927636/
28. Fagre AC, Lee JS, Kityo RM, et al. Discovery and Characterization of Bukakata orbivirus (Reoviridae: Orbivirus), a Novel Virus from a Ugandan Bat. Viruses. 2019; 11(3). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6466370/
29. Fernando R, Capone D, Elrich S, et al. Infection with New York Orthohantavirus and Associated Respiratory Failure and Multiple Cerebral Complications. Emerg Infect Dis. 2019; 25(6):1241-1243. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6537728/
30. Flint M, Chatterjee P, Lin DL, et al. A genome-wide CRISPR screen identifies N-acetylglucosamine-1-phosphate transferase as a potential antiviral target for Ebola virus. Nat Commun. 2019; 10(1):285. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6336797/
31. Gary JM, Welch SR, Ritter JM, et al. Lassa Virus Targeting of Anterior Uvea and Endothelium of Cornea and Conjunctiva in Eye of Guinea Pig Model. Emerg Infect Dis. 2019; 25(5):865-874. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6478213/
32. Genzer SC, Huynh T, Coleman-Mccray JD, Harmon JR, Welch SR, Spengler JR. Hematology and Clinical Chemistry Reference Intervals for Inbred Strain 13/n Guinea Pigs (Cavia Porcellus). J Am Assoc Lab Anim Sci. 2019; 58(3):293-303. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6526494/
33. Genzer SC, Welch SR, Scholte FEM, et al. Alterations in Blood Chemistry Levels Associated With Nipah Virus Disease in the Syrian Hamster Model. J Infect Dis. 2019. https://www.ncbi.nlm.nih.gov/pubmed/?term=Alterations+in+Blood+Chemistry+Levels+Associated+With+Nipah+Virus+Disease+in+the+Syrian+Hamster+Model
34. He YX, Ye CL, Zhang P, et al. Yersinia pseudotuberculosis Exploits CD209 Receptors for Promoting Host Dissemination and Infection. Infect Immun. 2019; 87(1). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6300620/
35. Hegde ST, Salje H, Sazzad HMS, et al. Using healthcare-seeking behaviour to estimate the number of

Nipah outbreaks missed by hospital-based surveillance in Bangladesh. Int J Epidemiol. 2019; 48(4):1219-1227. https://www.ncbi.nlm.nih.gov/pubmed/?term=Using+healthcare-seeking+behaviour+to+estimate+the+number+of+Nipah+outbreaks+missed+by+hospital-based+surveillance+in+Bangladesh

36. Jones MEB, Amman BR, Sealy TK, et al. Clinical, Histopathologic, and Immunohistochemical Characterization of Experimental Marburg Virus Infection in A Natural Reservoir Host, the Egyptian Rousette Bat (Rousettus aegyptiacus). Viruses. 2019; 11(3). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6466277/
37. Kainulainen MH, Spengler JR, Welch SR, et al. Protection From Lethal Lassa Disease Can Be Achieved Both Before and After Virus Exposure by Administration of Single-Cycle Replicating Lassa Virus Replicon Particles. J Infect Dis. 2019; 220(8):1281-1289. https://www.ncbi.nlm.nih.gov/pubmed/?term=Protection+From+Lethal+Lassa+Disease+Can+Be+Achieved+Both+Before+and+After+Virus+Exposure+by+Administration+of+Single-Cycle+Replicating+Lassa+Virus+Replicon+Particles
38. Kuhn JH, Amarasinghe GK, Basler CF, et al. ICTV Virus Taxonomy Profile: Filoviridae. J Gen Virol. 2019;100(6):911-912. https://www.microbiologyresearch.org/content/journal/jgv/10.1099/jgv.0.001252#tab2
39. Liu WJ, Sesay FR, Coursier A, et al. Comprehensive Clinical and Laboratory Follow-up of a Female Patient With Ebola Virus Disease: Sierra Leone Ebola Virus Persistence Study. Open Forum Infect Dis. 2019;6(3): ofz068. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6440679/
40. Lo MK, Feldmann F, Gary JM, et al. Remdesivir (GS-5734) protects African green monkeys from Nipah virus challenge. Sci Transl Med. 2019; 11(494). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6732787/
41. Lo MK, Spengler JR, Welch SR, et al. Evaluation of a Single-Dose Nucleoside-Modified Messenger RNA Vaccine Encoding Hendra Virus-Soluble Glycoprotein Against Lethal Nipah virus Challenge in Syrian Hamsters. J Infect Dis. 2019. https://www.ncbi.nlm.nih.gov/pubmed/?term=Evaluation+of+a+Single-Dose+Nucleoside-Modified+Messenger+RNA+Vaccine+Encoding+Hendra+Virus-Soluble+Glycoprotein+Against+Lethal+Nipah+virus+Challenge+in+Syrian+Hamsters.
42. Maes P, Amarasinghe GK, Ayllon MA, et al. Taxonomy of the order Mononegavirales: second update 2018. Arch Virol. 2019; 164(4):1233-1244. https://www.ncbi.nlm.nih.gov/pubmed/?term=Taxonomy+of+the+order+Mononegavirales%3A+second+update+2018
43. McElroy AK, Shrivastava-Ranjan P, Harmon JR, et al. Macrophage Activation Marker Soluble CD163 Associated with Fatal and Severe Ebola Virus Disease in Humans(1). Emerg Infect Dis. 2019; 25(2):290-298. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6346465/
44. McMullan LK, Flint M, Chakrabarti A, et al. Characterisation of infectious Ebola virus from the ongoing outbreak to guide response activities in the Democratic Republic of the Congo: a phylogenetic and in vitro analysis. Lancet Infect Dis. 2019; 19(9):1023-1032. https://www.sciencedirect.com/science/article/pii/S1473309919302919?via%3Dihub
45. Nyakarahuka L, Shoemaker TR, Balinandi S, et al. Marburg virus disease outbreak in Kween District Uganda, 2017: Epidemiological and laboratory findings. *PLoS Neglected Trop Dis.* 2019;13(3): e0007257. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6438581/
46. Pickering BS, Spengler JR, Shadabi E, Dalziel AE, Lautner EA, Silva P. The Biosafety Level 4 Zoonotic Laboratory Network (BSL4ZNet): Report of a workshop on live animal handling. Antiviral Res. 2019; 172:104640. https://www.sciencedirect.com/science/article/pii/S0166354219305522?via%3Dihub
47. Prescott J, Guito JC, Spengler JR, et al. Rousette Bat Dendritic Cells Overcome Marburg Virus-Mediated Antiviral Responses by Upregulation of Interferon-Related Genes While Downregulating Proinflammatory Disease Mediators. mSphere. 2019; 4(6).

48. https://www.ncbi.nlm.nih.gov/pubmed/31801842Reichler MR, Bruden D, Thomas H, et al. Ebola Patient Virus Cycle Threshold and Risk of Household Transmission of Ebola Virus. J Infect Dis. 2019. https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiz511/5681532
49. Scholte FEM, Hua BL, Spengler JR, et al. Stable Occupancy of the Crimean-Congo Hemorrhagic Fever Virus-Encoded Deubiquitinase Blocks Viral Infection. mBio. 2019; 10(4). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6650548/
50. Scholte FEM, Spengler JR, Welch SR, et al. Single-dose replicon particle vaccine provides complete protection against Crimean-Congo hemorrhagic fever virus in mice. Emerg Microbes Infect. 2019;8(1):575-578. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6455139/
51. Schuh AJ, Amman BR, Sealy TK, et al. Antibody-Mediated Virus Neutralization Is Not a Universal Mechanism of Marburg, Ebola, or Sosuga Virus Clearance in Egyptian Rousette Bats. J Infect Dis. 2019; 219(11):1716-1721. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6519049/
52. Schuh AJ, Amman BR, Sealy TS, et al. Comparative analysis of serologic cross-reactivity using convalescent sera from filovirus-experimentally infected fruit bats. Sci Rep. 2019; 9(1):6707. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6491471/
53. Shastri B, Kofman A, Hennenfent A, et al. Domestically Acquired Seoul Virus Causing Hemophagocytic Lymphohistiocytosis-Washington, DC, 2018. Open Forum Infect Dis. 2019; 6(10):ofz404. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6790396/
54. Spengler JR, Bergeron E, Spiropoulou CF. Crimean-Congo hemorrhagic fever and expansion from endemic regions. Curr Opin Virol. 2019;34:70-78. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6497153/
55. Spengler JR, Welch SR, Genzer SC, et al. Suboptimal Handling of Piccolo Samples or Reagent Discs for Consideration in Ebola Response. Emerg Infect Dis. 2019; 25(6):1238-1240. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6537746/
56. Spengler JR, Welch SR, Scholte FEM, et al. Heterologous protection against Crimean-Congo hemorrhagic fever in mice after a single dose of replicon particle vaccine. Antiviral Res. 2019; 170:104573. https://www.ncbi.nlm.nih.gov/pubmed/?term=Heterologous+protection+against+CrimeanCongo+hemorrhagic+fever+in+mice+after+a+single+dose+of+replicon+particle+vaccine
57. Spiropoulou CF. Nipah Virus Outbreaks: Still Small but Extremely Lethal. J Infect Dis. 2019; 219(12):1855-1857. https://academic.oup.com/jid/article/219/12/1855/5144923
58. Tramontano E, Tarbet B, Spengler JR, et al. Meeting report: 32nd International Conference on Antiviral Research. Antiviral Res. 2019; 169:104550. https://www.sciencedirect.com/science/article/pii/S0166354219303596?via%3Dihub
59. Welch SR, Ritter JM, McElroy AK, et al. Fluorescent Crimean-Congo hemorrhagic fever virus illuminates tissue tropism patterns and identifies early mononuclear phagocytic cell targets in IFNAR-/- mice. PLoS Pathogens. 2019; 15(12):e1008183. https://journals.plos.org/plospathogens/article?id=10.1371/journal.ppat.1008183
60. Welch SR, Scholte FEM, Harmon JR, et al. In Situ Imaging of Fluorescent Nipah Virus Respiratory and Neurological Tissue Tropism in the Syrian Hamster Model. J Infect Dis. 2019. https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiz393/5610252
61. Welch SR, Scholte FEM, Harmon JR, et al. Corrigendum to: In Situ Imaging of Fluorescent Nipah Virus Respiratory and Neurological Tissue Tropism in the Syrian Hamster Model. J Infect Dis. 2019. https://academic.oup.com/jid/advance-article/doi/10.1093/infdis/jiz627/5691358
62. Wiley MR, Fakoli L, Letizia AG, et al. Lassa virus circulating in Liberia: a retrospective genomic characterisation. Lancet Infect Dis. 2019; 19(12):1371-1378. https://www.sciencedirect.com/science/article/pii/S1473309919304864?via%3Dihub
63. Yadav PD, Whitmer SLM, Sarkale P, et al. Characterization of Novel Reoviruses Wad Medani Virus (Orbivirus) and Kundal Virus (Coltivirus) Collected from Hyalomma anatolicum Ticks in India during Surveillance for Crimean Congo Hemorrhagic Fever. J Virol. 2019; 93(13).

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6580951/

64. Yang K, He Y, Park CG, et al. Yersinia pestis Interacts With SIGNR1 (CD209b) for Promoting Host Dissemination and Infection. Front Immunol. 2019; 10:96. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6422942/
65. Yates MK, Chatterjee P, Flint M, et al. Probing the Effects of Pyrimidine Functional Group Switches on Acyclic Fleximer Analogues for Antiviral Activity. Molecules (Basel, Switzerland). 2019; 24(17). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6749450/
66. Ye C, Li Q, Li X, et al. Salmonella enterica Serovar Typhimurium Interacts with CD209 Receptors To Promote Host Dissemination and Infection. Infect Immun. 2019; 87(8). https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6652768/
67. Gargis AS, Lascols C, McLaughlin HP, Conley AB, Hoffmaster AR, Sue D. Genome Sequences of Penicillin Resistant Bacillus anthracis Strains. Microbiol Resour Announc. 2019 Jan 108(2). https://mra.asm.org/content/8/2/e01122-18
68. Gargis, A.S., Cherney, B., Conley, A.B. et al. Rapid Detection of Genetic Engineering, Structural Variation, and Antimicrobial Resistance Markers in Bacterial Biothreat Pathogens by Nanopore Sequencing. Sci Rep 9, 13501 (2019). https://www.nature.com/articles/s41598-019-49700-1
69. Villanueva, J., Schweitzer, B., Odle, M., & Aden, T. (2019). Detecting Emerging Infectious Diseases: An Overview of the Laboratory Response Network for Biological Threats. Public Health Rep, 134(2_suppl), 16S-21S. https://journals.sagepub.com/doi/10.1177/0033354919874354
70. Miernyk KM, Bruden D, Parkinson AJ, Hurlburt D, Klejka J, Berner J et al. Human Seroprevalence to 11 Zoonotic Pathogens in the U.S. Arctic, Alaska. Vector Borne Zoonotic Dis. 2019 Aug; 19(8):563-575. doi: 10.1089/vbz.2018.2390. Epub 2019 Feb 21.https://www.ncbi.nlm.nih.gov/pubmed/30789314
71. Wiley Z, Reddy S, Jacobs Slifka KM, Brandon DC, Jernigan J, Kersh GJ, Armstrong PA. Chronic Q Fever with Vascular Involvement: Progressive Abdominal Pain in a Patient with Aortic Aneurysm Repair in the United States. Case Rep Infect Dis. 2019 Feb 19;2019 https://www.ncbi.nlm.nih.gov/pubmed/30915246
72. Kersh GJ, Fitzpatrick K, Pletnikoff K, Brubaker M, Bruce M, Parkinson A. Prevalence of serum antibodies to Coxiella burnetii in Alaska Native Persons from the Pribilof Islands. Zoonoses Public Health. 2020 Feb; 67(1):89-92. doi: 10.1111/zph.12661. Epub 2019 Nov 8; https://www.ncbi.nlm.nih.gov/pubmed/31705592
73. Smith CB, Evavold C, Kersh GJ. The Effect of pH on Antibiotic Efficacy against Coxiella burnetii in Axenic Media. Sci Rep. 2019 Dec 2; 9(1):18132; https://www.ncbi.nlm.nih.gov/pubmed/31792307
74. Andayi F, Chaves SS, Widdowson MA. Impact of the 1918 Influenza Pandemic in Coastal Kenya. Trop Med Infect Dis. 2019 Jun 8; 4(2). pii: E91. doi: 10.3390/tropicalmed4020091, PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31181715
75. Jester B, Uyeki TM, Jernigan DB, Tumpey TM. Historical and clinical aspects of the 1918 H1N1 pandemic in the United States. Virology. 2019; 527**:**32-37. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/30453209
76. Lafond KE, Praptiningsih CY, Mangiri A, Syarif M, Triada R, Mulyadi E, et al. Seasonal Influenza and Avian Influenza A(H5N1) Virus Surveillance among Inpatients and Outpatients, East Jakarta, Indonesia, 2011-2014. Emerg Infect Dis. 2019; 25**:**2031-2039. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31625837
77. Levine MZ, Holiday C, Jefferson S, Gross FL, Liu F, Li S, et al. Heterologous prime-boost with A(H5N1) pandemic influenza vaccines induces broader cross-clade antibody responses than homologous prime-boost. NPJ Vaccines. 2019; 4**:**22. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31149353
78. Olsen SJ, Rooney JA, Blanton L, Rolfes MA, Nelson DI, Gomez TM at al. Estimating Risk to Responders Exposed to Avian Influenza A H5 and H7 Viruses in Poultry, United States, 2014-2017.

Emerg Infect Dis. 2019; 25:1011-1014. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/30741630

79. Poirot E, Levine MZ, Russell K, Stewart RJ, Pompey JM, Chiu S et al. Detection of Avian Influenza A(H7N2) Virus Infection Among Animal Shelter Workers Using a Novel Serological Approach-New York City, 2016-2017. J Infect Dis. 2019; 219:1688-1696. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/30395249
80. Sun X, Belser JA, Pappas C, Pulit-Penaloza JA, Brock N, Zeng H et al. Correction for Sun et al., Risk Assessment of Fifth-Wave H7N9 Influenza A Viruses in Mammalian Models. J Virol. 2019 June 14; 93(13). PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31201279
81. Sun X, Belser JA, Pappas C, Pulit-Penaloza JA, Brock N, Zeng H, Creager HM et al. Risk Assessment of Fifth-Wave H7N9 Influenza A Viruses in Mammalian Models. J Virol. 2018 Dec 10; 93(1). pii: e01740-18. doi: 10.1128/JVI.01740-18. Print 2019 Jan 1. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/30305359
82. Sun X, Belser JA, Yang H, Pulit-Penaloza JA, Pappas C, Brock N et al. Identification of key hemagglutinin residues responsible for cleavage, acid stability, and virulence of fifth-wave highly pathogenic avian influenza A(H7N9) viruses. Virology. 2019; 535:232-240. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31325838
83. Wang X, Wu P, Pei Y, Tsang TK, Gu D, Wang W et al. Assessment of Human-to-Human Transmissibility of Avian Influenza A(H7N9) Virus Across 5 Waves by Analyzing Clusters of Case Patients in Mainland China, 2013-2017. Clin Infect Dis. 2019; 68:623-631. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/29961834
84. Yang G, Chowdury S, Hodges E, Rahman MZ, Jang Y, Hossain ME et al. Detection of highly pathogenic avian influenza A(H5N6) viruses in waterfowl in Bangladesh. Virology. 2019; 534:36-44. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31176062
85. Zeng H, Goldsmith CS, Kumar A, Belser JA, Sun X, Pappas C et al. Tropism and Infectivity of a Seasonal A(H1N1) and a Highly Pathogenic Avian A(H5N1) Influenza Virus in Primary Differentiated Ferret Nasal Epithelial Cell Cultures. J Virol. 2019 May 1; 93(10). PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/30814288
86. Zhong W, Levine MZ. Stockpiled Avian Influenza A(H7N9) Vaccines Induce Robust, Nonneutralizing Functional Antibodies Against Antigenically Drifted Fifth-Wave A(H7N9) Viruses. J Infect Dis. 2019; 220:1276-1280. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31169293
87. Zhou L, Li Q, Uyeki TM. Estimated Incubation Period and Serial Interval for Human-to-Human Influenza A(H7N9) Virus Transmission. Emerg Infect Dis. 2019; 25:1982-1983. PubMed Central: https://www.ncbi.nlm.nih.gov/pubmed/31264568
88. Bower W, Schiffer J, Atmar R, Keitel W, Friedlander A, Liu L et al. Use of Anthrax Vaccine in the United States: Recommendations of the Advisory Committee on Immunization Practices, . MMWR. 2019; 68(No. RR-4); 1-14. DOI: http://dx.doi.org/10.15585/mmwr.rr6804a1

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives**:** Activities include developing diagnostic assays for public health, developing and validating methods to differentiate and characterize organisms and the toxins that they produce, testing environmental samples for the presence of microorganisms and toxins, and developing environmental sampling methods, conducting molecular and antigenic characterization of organisms, determining pathogenicity and virulence of infectious agents, evaluation of antimicrobial susceptibility, research on potential therapeutics, determining the natural history of infectious organisms, and conducting epidemiologic studies and surveillance for diseases.

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[*] Including viruses and prions.

Microorganisms and/or toxins studied: Select Agents (HHS, USDA, Overlap), Select Toxins (HHS), NIAID Category A pathogens

Outdoor Studies**:** No outdoor studies of biological aerosols were conducted at the facility or off-site by facility personnel.

1. What is the name of the facility?
Centers for Disease Control and Prevention (CDC), Deputy Director for Infectious Diseases (DDID), National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Vector Borne Diseases (DVBD) - Ft. Collins

2. Where is it located (include both address and geographical location)?
3156 Rampart Road, Fort Collins, Colorado 80521

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	0 m^2
BSL-3	421 m^2
BSL-4	0 m^2
Total laboratory floor area	421 m^2

4. The organizational structure of each facility.

(i)	**Total number of personnel**	31
(ii)	**Division of personnel**:	
	Military	0
	Civilian	31
(iii)	**Division of personnel by category**:	
	Scientists	5
	Engineers	0
	Technicians	8
	Administrative and support staff	18

(iv) List the scientific disciplines represented in the scientific/engineering staff.
Animal Science, Bacteriology, Bioinformatics, Biological Science, Cell Biology, Ecology, Entomology, Environmental Science, Epidemiology, Genomics, Immunology, Medicine, Microbiology, Molecular Biology, Molecular Diagnostics, Pathology, Public Health, Structural Biology, Veterinary Medicine, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number.
Yes Number: 2

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Health & Human Services

(vii) What are the funding levels for the following programme areas:

Research	$544,402
Development	$0
Test and evaluation	$0
Total	$544,402

(viii) Briefly describe the publication policy of the facility:

Publication is encouraged and managed by editorial and clearance policies conducted at all levels of the Agency. The clearance policy for information products disseminated outside CDC for public use is available online at: http://www.cdc.gov/od/science/policies. CDC also has an internal policy on "Oversight and clearance of dual use research of concern."

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Nelson CA, Murua C, Jones JM, Mohler K, Zhang Y, Wiggins L, et al; Francisella tularensis Transmission by Solid Organ Transplantation, 2017. Emerg Infect Dis. 2019 Apr; 25(4):767-775. doi: 10.3201/eid2504.181807. Epub 2019 Apr 17. PMID:30730826 https://wwwnc.cdc.gov/eid/article/25/4/18-1807_article
2. Harrist A, Cherry C, Kwit N, Bryan K, Pappert R, Petersen J, et al. Francisella tularensis Exposure Among National Park Service Employees During an Epizootic: Devils Tower National Monument, Wyoming, 2015. Vector Borne Zoonotic Dis. 2019 May; 19(5):316-322. doi: 10.1089/vbz.2018.2360. Epub 2018 Dec 1. PMID:30508402 https://www.ncbi.nlm.nih.gov/pubmed/30508402
3. Prentice KW, DePalma L, Ramage JG, Sarwar J, Parameswaran N, Petersen J, et al. Comprehensive Laboratory Evaluation of a Lateral Flow Assay for the Detection of Yersinia pestis. Health Secur. 2019 Nov/Dec; 17(6):439-453. https://www.ncbi.nlm.nih.gov/pubmed/31859568

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

***Objectives*:** CDC's Division of Vector Borne Diseases (DVBD) possesses many of the select agents that are on the Department of Health and Human Services (HHS) and HHS/U.S. Department of Agriculture overlap lists. Within CDC, DVBD has the primary responsibility for research on tularemia, plague and alphaviruses. This research involves development of assays for surveillance and detection of each agent and molecular and antigenic characterization.

Microorganisms and/or toxins studied: Select Agents (HHS, Overlap), NIAID Category A pathogens

***Outdoor Studies*:** No outdoor studies of biological aerosols were conducted at the facility or off-site by facility personnel.

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[*] Including viruses and prions.

Form A, Part 2 (iii)

National biological defence research and development programmes

1. What is the name of the facility?
Integrated Research Facility at Rocky Mountain Laboratories (IRF-RML)

2. Where is it located (include both address and geographical location)?
903 South 4th Street, Hamilton, Montana 59840

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	1361 m^2
BSL-3	407 m^2
BSL-4	1145 m^2
Total laboratory floor area	2913 m^2

4. The organizational structure of each facility.

(i)	**Total number of personnel**	120

(ii)	**Division of personnel**:	
	Military	0
	Civilian	120

(iii)	**Division of personnel by category**:	
	Scientists	69
	Engineers	0
	Technicians	44
	Administrative and support staff	7

(iv) List the scientific disciplines represented in the scientific/engineering staff.
Aerobiology, Animal Science, Bacteriology, Biochemistry, Biological Science, Cell Biology, Entomology, Genetics, Genomics, Immunology, Mass Spectrometry, Microbiology, Microscopy, Molecular Biology, Pathology, Proteomics, Veterinary Medicine, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number.
Yes Number: 6

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
Department of Health and Human Services (HHS)

(vii) What are the funding levels for the following programme areas:

Research	$28,625,007
Development	$0
Test and evaluation	$0
Total	$28,625,007

(viii) Briefly describe the publication policy of the facility:
All researchers are encouraged to publish results in peer-reviewed open literature. The NIH Public Access Policy (http://publicaccess.nih.gov/) ensures that the public has access to the published results of NIH

funded research. It requires scientists to submit final peer-reviewed journal manuscripts that arise form NIH funds to the National Library of Medicine's PubMed Central digital archive upon acceptance for publication. To help advance science and improve human health, the policy requires that these papers are accessible to the public on PubMed Central no later than 12 months after publication.

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Adney DR, Letko M, Ragan IK, Scott D, van Doremalen N, Bowen RA, et al. Bactrian camels shed large quantities of Middle East respiratory syndrome coronavirus (MERS-CoV) after experimental infection. Emerg Microbes Infect. 2019; 8(1): 717-723. doi:10.1080/22221751.2019.1618687. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1080%2F22221751.2019.1618687
2. Adney DR, Wang L, van Doremalen N, Shi W, Zhang Y, Kong WP, et al. Efficacy of an Adjuvanted Middle East Respiratory Syndrome Coronavirus Spike Protein Vaccine in Dromedary Camels and Alpacas. Viruses. 2019; 11(3). doi:10.3390/v11030212. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11030212
3. Avanzato VA, Oguntuyo KY, Escalera-Zamudio M, Gutierrez B, Golden M, Kosakovsky Pond SL, et al.. A structural basis for antibody-mediated neutralization of Nipah virus reveals a site of vulnerability at the fusion glycoprotein apex. Proc Natl Acad Sci U S A. 2019; 116(50): 25057-25067. doi:10.1073/pnas.1912503116. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1073%2Fpnas.1912503116
4. Baiardi S, Redaelli V, Ripellino P, Rossi M, Franceschini A, Moggio M, et al. Prion-related peripheral neuropathy in sporadic Creutzfeldt-Jakob disease. J Neurol Neurosurg Psychiatry. 2019; 90(4): 424-427. doi:10.1136/jnnp-2018-319221. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1136%2Fjnnp-2018-319221
5. Baril L, Valles X, Stenseth NC, Rajerison M, Ratsitorahina M., Pizarro-Cerda J, et al. Can we make human plague history? A call to action. BMJ Global Health. 2019; 4(6), e001984. doi:10.1136/bmjgh-2019-001984. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1136%2Fbmjgh-2019-001984
6. Baskakov IV, Caughey B, Requena JR, Sevillano AM, Surewicz WK, Wille H. The prion 2018 round tables (I): the structure of PrP(Sc). Prion. 2019; 13(1): 46-52. doi:10.1080/19336896.2019.1569450. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1080%2F19336896.2019.1569450
7. Bennett AJ, Bushmaker T, Cameron K, Ondzie A, Niama FR, Parra HJ et al. Corrigendum to Diverse RNA viruses of arthropod origin in the blood of fruit bats suggest a link between bat and arthropod viromes [Virology 528 (2019) 64-72]. Virology. 2019; 528. doi:10.1016/j.virol.2019.01.020. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.virol.2019.01.020
8. Best SM, Ponia SS. Regulation of type I interferon: It's HIP to be K2. Sci Signal. 2019; 12(573). doi:10.1126/scisignal.aaw8549. https://www.ncbi.nlm.nih.gov/pubmed/30890660
9. Boardman K, Rosenke K, Safronetz D, Feldmann H, Schwan TG. Host Competency of the Multimammate Rat Mastomys natalensis Demonstrated by Prolonged Spirochetemias with the African Relapsing Fever Spirochete Borrelia crocidurae. Am J Trop Med Hyg. 2019; 101(6): 1272-1275. doi:10.4269/ajtmh.19-0590. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.4269%2Fajtmh.19-0590
10. Bontemps-Gallo S, Fernandez M, Dewitte A, Raphael E, Gherardini FC, Elizabeth P et al. Nutrient depletion may trigger the Yersinia pestis OmpR-EnvZ regulatory system to promote flea-borne plague transmission. Mol Microbiol. 2019; 112(5): 1471-1482. doi:10.1111/mmi.14372. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1111%2Fmmi.14372
11. Boyle WK, Groshong AM, Drecktrah D, Boylan JA, Gherardini FC, Blevins JS, et al. DksA Controls the Response of the Lyme Disease Spirochete Borrelia burgdorferi to Starvation. J Bacteriol. 2019; 201(4). doi:10.1128/jb.00582-18.

https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjb.00582-18

12. Carroll JA, Chesebro B. Neuroinflammation, Microglia, and Cell-Association during Prion Disease. Viruses, 2019; 11(1). doi:10.3390/v11010065. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11010065
13. Caughey B, Kraus A. Transmissibility versus Pathogenicity of Self-Propagating Protein Aggregates. Viruses. 2019; 11(11). doi:10.3390/v11111044. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11111044
14. Chiramel AI, Meyerson NR, McNally KL, Broeckel RM, Montoya VR, Mendez-Solis O. et al. TRIM5alpha Restricts Flavivirus Replication by Targeting the Viral Protease for Proteasomal Degradation. Cell Rep. 2019; 27(11): 3269-3283.e3266. doi:10.1016/j.celrep.2019.05.040. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.celrep.2019.05.040
15. Chong A, Starr T, Finn CE, Steele-Mortimer O. A role for the Salmonella Type III Secretion System 1 in bacterial adaptation to the cytosol of epithelial cells. Mol Microbiol 2019; 112(4): 1270-1283. doi:10.1111/mmi.14361. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1111%2Fmmi.14361
16. Chouikha I, Sturdevant DE, Jarrett C, Sun YC, Hinnebusch BJ. Differential Gene Expression Patterns of Yersinia pestis and Yersinia pseudotuberculosis during Infection and Biofilm Formation in the Flea Digestive Tract. mSystems. 2019; *4*(1). doi:10.1128/mSystems.00217-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmSystems.00217-18
17. de Wit E, Feldmann F, Horne E, Okumura A, Cameroni E, Haddock E et al. Prophylactic efficacy of a human monoclonal antibody against MERS-CoV in the common marmoset. Antiviral Res.2019; 163: 70-74. doi:10.1016/j.antiviral.2019.01.016. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.antiviral.2019.01.016
18. do Carmo Ferreira N, Caughey B. Cell-free prion protein conversion assays in screening for anti-prion drug candidates. Curr Opin Pharmacol. 2019; 44: 1-7. doi:10.1016/j.coph.2018.10.001. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.coph.2018.10.001
19. Edenborough KM, Bokelmann M, Lander A, Couacy-Hymann E, Lechner J, Drechsel O et al. Dendritic Cells Generated From Mops condylurus, a Likely Filovirus Reservoir Host, Are Susceptible to and Activated by Zaire Ebolavirus Infection. Front Immunol. 2019; 10: 2414. doi:10.3389/fimmu.2019.02414. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3389%2Ffimmu.2019.02414
20. Evans AB, Peterson KE. Throw out the Map: Neuropathogenesis of the Globally Expanding California Serogroup of Orthobunyaviruses. Viruses. 2019; 11(9). doi:10.3390/v11090794. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11090794
21. Evans AB, Winkler CW, Peterson KE. Differences in Neuropathogenesis of Encephalitic California Serogroup Viruses. Emerg Infect Dis. 2019; 25(4): 728-738. doi:10.3201/eid2504.181016. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3201%2Feid2504.181016
22. Faris R, Merling M, Andersen SE, Dooley CA, Hackstadt T, Weber MM. Chlamydia trachomatis CT229 Subverts Rab GTPase-Dependent CCV Trafficking Pathways to Promote Chlamydial Infection. Cell Rep. 2019; 26(12): 3380-3390.e3385. doi:10.1016/j.celrep.2019.02.079. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.celrep.2019.02.079
23. Favole A, Mazza M, Vallino Costassa E, D'Angelo A, Lombardi G, Marconi P et al. Early and Pre-Clinical Detection of Prion Seeding Activity in Cerebrospinal Fluid of Goats using Real-Time Quaking-Induced Conversion Assay. Sci Rep. 2019; 9(1): 6173. doi:10.1038/s41598-019-42449-7. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41598-019-42449-7
24. Feldmann F, Kobasa D, Embury-Hyatt C, Grolla A, Taylor T, Kiso M et al. Oseltamivir Is Effective against 1918 Influenza Virus Infection of Macaques but Vulnerable to Escape. mBio. 2019; 10(5). doi:10.1128/mBio.02059-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02059-19
25. Feldmann F, Shupert WL, Haddock E, Twardoski B, Feldmann H. Gamma Irradiation as an Effective Method for Inactivation of Emerging Viral Pathogens. Am J Trop Med Hyg 2019; 100(5): 1275-

1277. doi:10.4269/ajtmh.18-0937. https://www.ncbi.nlm.nih.gov/pubmed/30860018

26. Gomes-Solecki M, Arnaboldi PM, Backenson PB, Benach JL, Cooper CL, Dattwyler RJ et al. Protective Immunity and New Vaccines for Lyme Disease. Clin Infect Dis. 2019. doi:10.1093/cid/ciz872. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Fcid%2Fciz872
27. Grabowski JM, Nilsson OR, Fischer ER, Long D, Offerdahl DK, Park Y et al. Dissecting Flavivirus Biology in Salivary Gland Cultures from Fed and Unfed Ixodes scapularis (Black-Legged Tick). mBio. 2019; 10(1). doi:10.1128/mBio.02628-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02628-18
28. Hawman DW, Meade-White K, Haddock E, Habib R, Scott D, Thomas T et al. Crimean-Congo Hemorrhagic Fever Mouse Model Recapitulating Human Convalescence. J Virol. 2019; 93(18). doi:10.1128/jvi.00554-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.00554-19
29. Hillman C, Stewart PE, Strnad M, Stone H, Starr T, Carmody A et al. Visualization of Spirochetes by Labeling Membrane Proteins With Fluorescent Biarsenical Dyes. Front Cell Infect Microbiol. 2019; 9: 287. doi:10.3389/fcimb.2019.00287. https://www.ncbi.nlm.nih.gov/pubmed/31482073
30. Hoenen T, Groseth A, Feldmann H. Therapeutic strategies to target the Ebola virus life cycle. Nat Rev Microbiol. 2019; 17(10): 593-606. doi:10.1038/s41579-019-0233-2. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41579-019-0233-2
31. Jessop F, Buntyn R, Schwarz B, Wehrly T, Scott D, Bosio CM. IFN-gamma reprograms host mitochondrial metabolism through inhibition of complex II to control intracellular bacterial replication. Infect Immun. 2019. doi:10.1128/iai.00744-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fiai.00744-19
32. Judson SD, Munster VJ. Nosocomial Transmission of Emerging Viruses via Aerosol-Generating Medical Procedures. Viruses. 2019; 11(10). doi:10.3390/v11100940. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11100940
33. Jutras BL, Savage CR, Arnold WK, Lethbridge KG, Carroll DW, Tilly K et al. The Lyme disease spirochete's BpuR DNA/RNA-binding protein is differentially expressed during the mammal-tick infectious cycle, which affects translation of the SodA superoxide dismutase. Mol Microbiol. 2019; 112(3): 973-991. doi:10.1111/mmi.14336. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1111%2Fmmi.14336
34. Kachroo P, Eraso JM, Beres SB, Olsen RJ, Zhu L, Nasser W et al. Integrated analysis of population genomics, transcriptomics and virulence provides novel insights into Streptococcus pyogenes pathogenesis. Nat Genet. 2019; 51(3): 548-559. doi:10.1038/s41588-018-0343-1. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41588-018-0343-1
35. Kobayashi SD, DeLeo FR. Towards a Monoclonal Antibody-Based Therapy for Prevention and Treatment of Staphylococcus aureus Infections. J Infect Dis. 2019; 219(6): 848-850. doi:10.1093/infdis/jiy667. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiy667
36. Kraus A, Saijo E, Metrick MA 2nd, Newell K, Sigurdson CJ, Zanusso G et al. Seeding selectivity and ultrasensitive detection of tau aggregate conformers of Alzheimer disease. Acta Neuropathol. 2019; 137(4): 585-598. doi:10.1007/s00401-018-1947-3. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2Fs00401-018-1947-3
37. Kuisma E, Olson SH, Cameron KN, Reed PE, Karesh WB, Ondzie AI et al. Correction to 'Long-term wildlife mortality surveillance in northern Congo: a model for the detection of Ebola virus disease epizootics'. Philos Trans R Soc Lond B Biol Sci. 2019; 374(1786), 20190658. doi:10.1098/rstb.2019.0658. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1098%2Frstb.2019.0658
38. Kuisma E, Olson SH, Cameron KN, Reed PE, Karesh WB, Ondzie AI et al. Long-term wildlife mortality surveillance in northern Congo: a model for the detection of Ebola virus disease epizootics. Philos Trans R Soc Lond B Biol Sci. 2019; 374(1782), 20180339. doi:10.1098/rstb.2018.0339. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1098%2Frstb.2018.0339

39. Lara A, Cong Y, Jahrling PB, Mednikov M, Postnikova E, Yu S et al. Peripheral immune response in the African green monkey model following Nipah-Malaysia virus exposure by intermediate-size particle aerosol. PLoS Negl Trop Dis. 2019; 13(6), e0007454. doi:10.1371/journal.pntd.0007454. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.pntd.0007454
40. Larson CL, Beare PA, Heinzen RA. Dependency of Coxiella burnetii Type 4B Secretion on the Chaperone IcmS. J Bacteriol. 2019; 201(23). doi:10.1128/jb.00431-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjb.00431-19
41. Larson CL, Sandoz KM, Cockrell DC, Heinzen RA. Noncanonical Inhibition of mTORC1 by Coxiella burnetii Promotes Replication within a Phagolysosome-Like Vacuole. mBio, 2019; 10(1). doi:10.1128/mBio.02816-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02816-18
42. Lee JH, Hammoud DA, Cong Y, Huzella LM, Castro MA, Solomon J et al. The Use of Large-Particle Aerosol Exposure to Nipah Virus to Mimic Human Neurological Disease Manifestations in the African Green Monkey. J Infect Dis. 2019 doi:10.1093/infdis/jiz502. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiz502
43. Lehrer AT, Wong TS, Lieberman MM, Johns L, Medina L, Feldmann F et al. Recombinant subunit vaccines protect guinea pigs from lethal Ebola virus challenge. Vaccine. 2019; 37(47): 6942-6950. doi:10.1016/j.vaccine.2019.06.035. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.vaccine.2019.06.035
44. Lo MK, Feldmann F, Gary JM, Jordan R, Bannister R, Cronin J et al. Remdesivir (GS-5734) protects African green monkeys from Nipah virus challenge. Sci Transl Med. 2019; 11(494). doi:10.1126/scitranslmed.aau9242. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscitranslmed.aau9242
45. Long CM, Beare PA, Cockrell DC, Larson CL, Heinzen RA. Comparative virulence of diverse Coxiella burnetii strains. Virulence. 2019; 10(1), 133-150. doi:10.1080/21505594.2019.1575715. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1080%2F21505594.2019.1575715
46. Lunn TJ, Restif O, Peel AJ, Munster VJ, de Wit E, Sokolow S et al. Dose-response and transmission: the nexus between reservoir hosts, environment and recipient hosts. Philos Trans R Soc Lond B Biol Sci. 2019; 374(1782), 20190016. doi:10.1098/rstb.2019.0016. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1098%2Frstb.2019.0016
47. Malachowa N, Kobayashi SD, Lovaglio J, DeLeo FR. Mouse Model of Staphylococcus aureus Skin Infection. Methods Mol Biol. 2019; 1960: 139-147. doi:10.1007/978-1-4939-9167-9_12. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2F978-1-4939-9167-9_12
48. Malachowa N, Kobayashi SD, Porter AR., Freedman B, Hanley PW., Lovaglio J et al. Vaccine Protection against Multidrug-Resistant Klebsiella pneumoniae in a Nonhuman Primate Model of Severe Lower Respiratory Tract Infection. mBio. 2019; 10(6). doi:10.1128/mBio.02994-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02994-19
49. Marzi A, Menicucci AR, Engelmann F, Callison J, Horne EJ, Feldmann F et al. Protection Against Marburg Virus Using a Recombinant VSV-Vaccine Depends on T and B Cell Activation. Front Immunol. 2019 Jan 22;9:3071. doi:10.3389/fimmu.2018.03071. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3389%2Ffimmu.2018.03071
50. Marzi A, Reynolds P, Mercado-Hernandez R, Callison J, Feldmann F, Rosenke R et al. Single low-dose VSV-EBOV vaccination protects cynomolgus macaques from lethal Ebola challenge. EBioMedicine. 2019; 49: 223-231. doi:10.1016/j.ebiom.2019.09.055. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.ebiom.2019.09.055
51. Matz KM, Marzi A, Feldmann H. Ebola vaccine trials: progress in vaccine safety and immunogenicity. Expert Rev Vaccines. 2019; 18(12), 1229-1242. doi:10.1080/14760584.2019.1698952. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1080%2F14760584.2019.1698952
52. Menicucci AR, Jankeel A, Feldmann H, Marzi A., Messaoudi I. Antiviral Innate Responses Induced

by VSV-EBOV Vaccination Contribute to Rapid Protection. mBio. 2019; 10(3). doi:10.1128/mBio.00597-19. https://www.ncbi.nlm.nih.gov/pubmed/31138743

53. Metrick MA 2nd, do Carmo Ferreira N, Saijo E., Hughson AG, Kraus A, Orru C et al. Million-fold sensitivity enhancement in proteopathic seed amplification assays for biospecimens by Hofmeister ion comparisons. Proc Natl Acad Sci U S A. 2019; 116(46): 23029-23039. doi:10.1073/pnas.1909322116. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1073%2Fpnas.1909322116
54. Miller HE, Hoyt FH, Heinzen RA. Replication of Coxiella burnetii in a Lysosome-Like Vacuole Does Not Require Lysosomal Hydrolases. Infect Immun. 2019; 87(11). doi:10.1128/iai.00493-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fiai.00493-19
55. Mlera L, Bloom ME. Differential Zika Virus Infection of Testicular Cell Lines. Viruses. 2019; 11(1). doi:10.3390/v11010042. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11010042
56. Moormeier DE, Sandoz KM, Beare PA, Sturdevant DE, Nair V, Cockrell DC et al. Coxiella burnetii RpoS Regulates Genes Involved in Morphological Differentiation and Intracellular Growth. J Bacteriol. 2019; 201(8). doi:10.1128/jb.00009-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjb.00009-19
57. Nilsson OR, Kari L, Steele-Mortimer O. Foodborne infection of mice with Salmonella Typhimurium. PLoS One. 2019; 14(8), e0215190. doi:10.1371/journal.pone.0215190. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.pone.0215190
58. Olson SH, Bounga G, Ondzie A, Bushmaker T, Seifert SN, Kuisma E et al. Lek-associated movement of a putative Ebolavirus reservoir, the hammer-headed fruit bat (Hypsignathus monstrosus), in northern Republic of Congo. PLoS One. 2019; 14(10), e0223139. doi:10.1371/journal.pone.0223139. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.pone.0223139
59. Ooi YS, Majzoub K, Flynn RA, Mata MA, Diep J, Li JK et al. An RNA-centric dissection of host complexes controlling flavivirus infection. Nat Microbiol. 2019; 4(12): 2369-2382. doi:10.1038/s41564-019-0518-2. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41564-019-0518-2
60. Opoku-Temeng C, Kobayashi SD, DeLeo FR. Klebsiella pneumoniae capsule polysaccharide as a target for therapeutics and vaccines. Comput Struct Biotechnol J. 2019; 17: 1360-1366. doi:10.1016/j.csbj.2019.09.011. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.csbj.2019.09.011
61. Poliquin G, Funk D, Jones S, Tran K, Ranadheera C, Hagan M et al. Correction to: Impact of intensive care unit supportive care on the physiology of Ebola virus disease in a universally lethal non-human primate model. Intensive Care Med Exp. 2019; 7(1): 66. doi:10.1186/s40635-019-0283-9. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1186%2Fs40635-019-0283-9
62. Poliquin G, Funk D, Jones S, Tran K, Ranadheera C, Hagan M et al. Impact of intensive care unit supportive care on the physiology of Ebola virus disease in a universally lethal non-human primate model. Intensive Care Med Exp. 2019; 7(1), 54. doi:10.1186/s40635-019-0268-8. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1186%2Fs40635-019-0268-8
63. Race B, Williams K, Chesebro B. Transmission studies of chronic wasting disease to transgenic mice overexpressing human prion protein using the RT-QuIC assay. Vet Res. 2019; 50(1): 6. doi:10.1186/s13567-019-0626-2. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1186%2Fs13567-019-0626-2
64. Raymond GJ, Zhao HT, Race B, Raymond LD, Williams K, Swayze EE et al. Antisense oligonucleotides extend survival of prion-infected mice. JCI Insight. 2019; 5. doi:10.1172/jci.insight.131175. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1172%2Fjci.insight.131175
65. Roberts LM, Evans TJ, Bosio CM. T Cell Metabolism Is Dependent on Anatomical Location within the Lung. Immunohorizons. 2019; 3(9): 433-439. doi:10.4049/immunohorizons.1900063. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.4049%2Fimmunohorizons.1900063

66. Rungelrath V, Kobayashi SD, DeLeo FR. Neutrophils in innate immunity and systems biology-level approaches. Wiley Interdiscip Rev Syst Biol Med. 2019; 12(1), e1458. doi:10.1002/wsbm.1458. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1002%2Fwsbm.1458
67. Saijo E, Groveman BR, Kraus A, Metrick M, Orru CD, Hughson AG, Caughey B. Ultrasensitive RT-QuIC Seed Amplification Assays for Disease-Associated Tau, alpha-Synuclein, and Prion Aggregates. Methods Mol Biol. 2019; 1873, 19-37. doi:10.1007/978-1-4939-8820-4_2. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2F978-1-4939-8820-4_2
68. Saijo E, Metrick MA 2nd, Koga S, Parchi P, Litvan I, Spina S et al. 4-Repeat tau seeds and templating subtypes as brain and CSF biomarkers of frontotemporal lobar degeneration. Acta Neuropathol. 2020; Jan;139(1):63-77. doi: 10.1007/s00401-019-02080-2. Epub 2019 Oct 16. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2Fs00401-019-02080-2
69. Schountz T, Campbell C, Wagner K, Rovnak J, Martellaro C, DeBuysscher BL et al. Differential Innate Immune Responses Elicited by Nipah Virus and Cedar Virus Correlate with Disparate In Vivo Pathogenesis in Hamsters. Viruses. 2019; 11(3). doi:10.3390/v11030291. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11030291
70. Seifert SN, Letko MC, Bushmaker T, Laing ED, Saturday G, Meade-White K et al. Rousettus aegyptiacus Bats Do Not Support Productive Nipah Virus Replication. J Infect Dis. 2019; doi:10.1093/infdis/jiz429. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiz429
71. Shannon JG, Hinnebusch BJ. Intravital Confocal Microscopy of Dermal Innate Immune Responses to Flea-Transmitted Yersinia pestis. Methods Mol Biol. 2019; 2010: 57-68. doi:10.1007/978-1-4939-9541-7_5. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2F978-1-4939-9541-7_5
72. Staffaroni AM, Kramer AO, Casey M, Kang H, Rojas JC, Orru CD et al. Association of Blood and Cerebrospinal Fluid Tau Level and Other Biomarkers With Survival Time in Sporadic Creutzfeldt-Jakob Disease. JAMA Neurol. 2019. doi:10.1001/jamaneurol.2019.1071. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1001%2Fjamaneurol.2019.1071
73. Striebel JF, Race B, Williams K, Carroll JA, Klingeborn M, Chesebro B. Microglia are not required for prion-induced retinal photoreceptor degeneration. Acta Neuropathol Commun. 2019; 7(1): 48. doi:10.1186/s40478-019-0702-x. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1186%2Fs40478-019-0702-x
74. Tang-Huau TL, Feldmann H, Rosenke K. Animal models for Lassa virus infection. Curr Opin Virol. 2019; 37: 112-117. doi:10.1016/j.coviro.2019.07.005. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.coviro.2019.07.005
75. van Doremalen N, Lambe T, Sebastian S, Bushmaker T, Fischer R, Feldmann F et al. A single-dose ChAdOx1-vectored vaccine provides complete protection against Nipah Bangladesh and Malaysia in Syrian golden hamsters. PLoS Negl Trop Dis. 2019; 13(6), e0007462. doi:10.1371/journal.pntd.0007462. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.pntd.0007462
76. Vinton CL, Magaziner SJ, Dowd KA, Robertson SJ, Amaro-Carambot E, Karmele EP et al. Simian Immunodeficiency Virus Infection of Rhesus Macaques Results in Delayed Zika Virus Clearance. mBio. 2019; 10(6). doi:10.1128/mBio.02790-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02790-19
77. Wang Z, Manca M, Foutz A, Camacho MV, Raymond GJ, Race B et al. Early preclinical detection of prions in the skin of prion-infected animals. Nat Commun. 2019; 10(1): 247. doi:10.1038/s41467-018-08130-9. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41467-018-08130-9
78. Wang Z, Manca M, Foutz A, Camacho MV, Raymond GJ, Race B et al. Publisher Correction: Early preclinical detection of prions in the skin of prion-infected animals. Nat Commun. 2019; 10(1): 640. doi:10.1038/s41467-019-08648-6. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41467-019-08648-6
79. Ward A, Hollister JR, Choi YP, Race B, Williams K, Shoup DW et al. Altered distribution,

aggregation, and protease resistance of cellular prion protein following intracranial inoculation. PLoS One. 2019; 14(7), e0219457. doi:10.1371/journal.pone.0219457. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.pone.0219457

80. Wasik BR, de Wit E, Munster V, Lloyd-Smith JO, Martinez-Sobrido L, Parrish CR. Onward transmission of viruses: how do viruses emerge to cause epidemics after spillover? Philos Trans R Soc Lond B Biol Sci. 2019; 374(1782), 20190017. doi:10.1098/rstb.2019.0017. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1098%2Frstb.2019.0017
81. Williams K, Hughson AG, Chesebro B, Race B. Inactivation of chronic wasting disease prions using sodium hypochlorite. PLoS One. 2019; 14(10), e0223659. doi:10.1371/journal.pone.0223659. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.pone.0223659
82. Winkler CW, Woods TA, Groveman BR, Carmody AB, Speranza EE, Martens CA et al. Neuronal maturation reduces the type I IFN response to orthobunyavirus infection and leads to increased apoptosis of human neurons. J Neuroinflammation. 2019; 16(1): 229. doi:10.1186/s12974-019-1614-1. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1186%2Fs12974-019-1614-1
83. Yinda CK, Seifert SN, Macmenamin P, van Doremalen N, Kim L, Bushmaker T et al. A Novel Field-Deployable Method for Sequencing and Analyses of Henipavirus Genomes From Complex Samples on the MinION Platform. J Infect Dis. 2019.. doi:10.1093/infdis/jiz576. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiz576
84. Youseff BH, Brewer TG, McNally KL, Izuogu AO, Lubick KJ, Presloid JB et al. TRAF6 Plays a Proviral Role in Tick-Borne Flavivirus Infection through Interaction with the NS3 Protease. iScience. 2019; 15: 489-501. doi:10.1016/j.isci.2019.05.010. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.isci.2019.05.010

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: The Integrated Research Facility at Rocky Mountain Laboratories hosts research dedicated to understanding the mechanisms of pathogenesis of microbial agents associated with or likely to cause serious or lethal human diseases using molecular methods and animal model systems. Research activities include pathogenesis studies, vaccinology, and the development of therapeutic countermeasures and rapid diagnostic assays in support of the civilian biodefense program. More information is available at https://www.niaid.nih.gov/about/rocky-mountain-laboratories.

Microorganisms and/or toxins studied: Select Agents (HHS, Overlap, USDA), NIAID Category A pathogens

Outdoor studies: No outdoor studies of biological aerosols were conducted.

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[*] Including viruses and prions.

National biological defence research and development programmes

1. What is the name of the facility?

Integrated Research Facility at Fort Detrick (IRF-Frederick)

2. Where is it located (include both address and geographical location)?

8200 Research Plaza, Frederick, Maryland 21702

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	878 m^2
BSL-3	0 m^2
BSL-4	1305 m^2
Total laboratory floor area	2183 m^2

4. The organizational structure of each facility.

(i)	**Total number of personnel**	91
(ii)	**Division of personnel**:	
	Military	0
	Civilian	91
(iii)	**Division of personnel by category**:	
	Scientists	22
	Engineers	2
	Technicians	62
	Administrative and support staff	5

(iv) List the scientific disciplines represented in the scientific/engineering staff.

Aerobiology, Aerosol Science, Analytical Biochemistry, Biochemistry, Biological Science, Cell Biology, Genomics, Immunology, Microbiology, Microscopy, Molecular Biology, Molecular Diagnostics, Pathology, Public Health, Veterinary Medicine, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number.

Yes Number: 88

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?

Department of Health and Human Services (HHS)

(vii) What are the funding levels for the following programme areas:

Research	$24,508,496
Development	$0
Test and evaluation	$0
Total	$24,508,496

(viii) Briefly describe the publication policy of the facility:

All researchers are encouraged to publish results in peer-reviewed open literature. The NIH Public Access Policy (http://publicaccess.nih.gov/) ensures that the public has access to the published results of NIH funded research. It requires scientists to submit final peer-reviewed journal manuscripts that arise form NIH funds to the National Library of Medicine's PubMed Central digital archive upon acceptance for publication. To help advance science and improve human health, the policy requires that these papers are accessible to the public on PubMed Central no later than 12 months after publication.

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Beigel JH, Aga E, Elie-Turenne MC, Cho J, Tebas P, Clark CL et al. Anti-influenza immune plasma for the treatment of patients with severe influenza A: a randomised, double-blind, phase 3 trial. Lancet Respir Med. 2019; 7(11): 941-950. doi:10.1016/s2213-2600(19)30199-7. https://www.ncbi.nlm.nih.gov/pubmed/31582360
2. Beigel JH, Manosuthi W, Beeler J, Bao Y, Hoppers M, Ruxrungtham K et al. Effect of Oral Oseltamivir on Virological Outcomes in Low-risk Adults With Influenza: A Randomized Clinical Trial. Clin Infect Dis. 2019;. doi:10.1093/cid/ciz634. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Fcid%2Fciz634
3. Bolay FK, Grandits G, Lane HC, Kennedy SB, Johnson MP, Fallah MP et al. PREVAIL I Cluster Vaccination Study With rVSVDeltaG-ZEBOV-GP as Part of a Public Health Response in Liberia. J Infect Dis. 2019; 219(10): 1634-1641. doi:10.1093/infdis/jiy698. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiy698
4. Chen P, Chen H, Moussa M, Cheng J, Li T, Qin J et al. rhIL-15 and anti-PD-L1 combination therapy expands a CXCR3+PD1-/low CD8 T cell subset in SIV-infected rhesus macaques. J Infect Dis. 2019; doi:10.1093/infdis/jiz485. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiz485
5. Cornish JP, Moore IN, Perry DL, Lara A, Minai M, Promeneur D et al. Clinical Characterization of Host Response to Simian Hemorrhagic Fever Virus Infection in Permissive and Refractory Hosts: A Model for Determining Mechanisms of VHF Pathogenesis. Viruses. 2019; 11(1). doi:10.3390/v11010067. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11010067
6. Davey RT Jr, Fernandez-Cruz E, Markowitz N, Pett S, Babiker AG, Wentworth D et al. Anti-influenza hyperimmune intravenous immunoglobulin for adults with influenza A or B infection (FLU-IVIG): a double-blind, randomised, placebo-controlled trial. Lancet Respir Med. 2019; 7(11): 951-963. doi:10.1016/s2213-2600(19)30253-x. https://www.ncbi.nlm.nih.gov/pubmed/31582358
7. Di Mascio M, Lifson JD, Srinivasula S, Kim I, DeGrange P, Keele BF et al. Evaluation of an antibody to alpha4beta7 in the control of SIVmac239-nef-stop infection. Science. 2019; 365(6457): 1025-1029. doi:10.1126/science.aav6695. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscience.aav6695
8. Dodd LE, Follmann D, Proschan M, Wang J, Malvy D, van Griensven J et al. A meta-analysis of clinical studies conducted during the West Africa Ebola virus disease outbreak confirms the need for randomized control groups. Sci Transl Med. 2019; 11(520). doi:10.1126/scitranslmed.aaw1049. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscitranslmed.aaw1049
9. Ekenberg C, Tang MH, Zucco AG, Murray DD, MacPherson CR, Hu X et al. Association Between Single-Nucleotide Polymorphisms in HLA Alleles and Human Immunodeficiency Virus Type 1 Viral Load in Demographically Diverse, Antiretroviral Therapy-Naive Participants From the Strategic Timing of AntiRetroviral Treatment Trial. J Infect Dis. 2019; 220(8): 1325-1334. doi:10.1093/infdis/jiz294. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiz294
10. Keshwara R, Hagen KR, Abreu-Mota T, Papaneri AB, Liu D, Wirblich C et al. A Recombinant Rabies Virus Expressing the Marburg Virus Glycoprotein Is Dependent upon Antibody-Mediated Cellular Cytotoxicity for Protection against Marburg Virus Disease in a Murine Model. J Virol. 2019; 93(6). doi:10.1128/jvi.01865-18.

https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.01865-18

11. Keshwara R, Shiels T, Postnikova E, Kurup D, Wirblich C, Johnson RF et al. Erratum: Publisher Correction: Rabies-based vaccine induces potent immune responses against Nipah virus. NPJ Vaccines. 2019; 4: 18. doi:10.1038/s41541-019-0112-x. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41541-019-0112-x
12. Keshwara R, Shiels T, Postnikova E, Kurup D, Wirblich C, Johnson RF et al. Rabies-based vaccine induces potent immune responses against Nipah virus. NPJ Vaccines. 2019; 4: 15. doi:10.1038/s41541-019-0109-5. https://www.ncbi.nlm.nih.gov/pubmed/31016033
13. Kuhn JH, Adachi T, Adhikari NK J, Arribas JR, Bah IE, Bausch DG et al. New filovirus disease classification and nomenclature. Nat Rev Microbiol. 2019; 17(5): 261-263. doi:10.1038/s41579-019-0187-4. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41579-019-0187-4
14. Liu DX, Perry DL, DeWald LE, Cai Y, Hagen KR, Cooper TK et al. Persistence of Lassa Virus Associated With Severe Systemic Arteritis in Convalescing Guinea Pigs (Cavia porcellus). J Infect Dis. 2019; 219(11): 1818-1822. doi:10.1093/infdis/jiy641. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiy641
15. Migueles SA, Chairez C, Lin S, Gavil NV, Rosenthal DM, Pooran M et al. Adoptive lymphocyte transfer to an HIV-infected progressor from an elite controller. JCI Insight. 2019; 4(18). doi:10.1172/jci.insight.130664. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1172%2Fjci.insight.130664
16. Mulangu S, Dodd LE, Davey RT Jr, Tshiani Mbaya O, Proschan M, Mukadi D et al. A Randomized, Controlled Trial of Ebola Virus Disease Therapeutics. N Engl J Med. 2019; 381(24): 2293-2303. doi:10.1056/NEJMoa1910993. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1056%2FNEJMoa1910993
17. Revell AD, Wang D, Perez-Elias MJ, Wood R, Tempelman H, Clotet B et al. Predicting Virological Response to HIV Treatment Over Time: A Tool for Settings With Different Definitions of Virological Response. J Acquir Immune Defic Syndr. 2019; 81(2): 207-215. doi:10.1097/qai.0000000000001989. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1097%2Fqai.0000000000001989
18. Sneller MC, Clarridge KE, Seamon C, Shi V, Zorawski MD, Justement JS et al. An open-label phase 1 clinical trial of the anti-alpha4beta7 monoclonal antibody vedolizumab in HIV-infected individuals. Sci Transl Med. 2019; 11(509). doi:10.1126/scitranslmed.aax3447. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscitranslmed.aax3447
19. Sneller MC, Reilly C, Badio M, Bishop RJ, Eghrari AO, Moses SJ et al. A Longitudinal Study of Ebola Sequelae in Liberia. N Engl J Med. 2019; 380(10): 924-934. doi:10.1056/NEJMoa1805435. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1056%2FNEJMoa1805435
20. Winchester NE, Maldarelli F, Mejia Y, Dee N, Dewar R, Laidlaw E et al. 8-Day Inpatient Directly Observed Therapy for ART Failure: A Tool For Preventing Unnecessary ART Changes and Optimizing Adherence Support. Clin Infect Dis. 2019. doi:10.1093/cid/ciz590. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Fcid%2Fciz590

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: The Integrated Research Facility at Fort Detrick in Frederick, Maryland manages, coordinates, and facilitates the conduct of emerging infectious disease and biodefense research to develop vaccines, countermeasures, and improved medical outcomes for patients. Battelle Memorial Institute facilitates research performed at the IRF-Frederick with direction from the IRF Scientific Steering Committee.

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[*] Including viruses and prions.

Microorganisms and/or Toxins Studied: Select Agents (HHS, Overlap) and Toxin (HHS), NIAID Category A pathogens

Outdoor studies: No outdoor studies of biological aerosols were conducted.

National biological defence research and development programmes

1. What is the name of the facility?
C.W. Bill Young Center for Biodefense and Emerging Infectious Diseases

2. Where is it located (include both address and geographical location)?
9000 Rockville Pike, Bethesda, Maryland 20892

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	2725 m^2
BSL-3	1356 m^2
BSL-4	0 m^2
Total laboratory floor area	4081 m^2

4. The organizational structure of each facility.

(i)	**Total number of personnel**	129

(ii) **Division of personnel**:

Military	0
Civilian	129

(iii) **Division of personnel by category**:

Scientists	69
Engineers	0
Technicians	54
Administrative and support staff	6

(iv) List the scientific disciplines represented in the scientific/engineering staff.
Bacteriology, Biological Science, Chemistry, Immunology, Medicine, Microbiology, Molecular Biology, Parasitology, Pathogenesis, Toxicology, Vaccine Evaluation, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number.
Yes Number: 29

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
Department of Health and Human Services (HHS)

(vii) What are the funding levels for the following programme areas:

Research	$35,024,216
Development	$0
Test and evaluation	$0
Total	$35,024,216

(viii) Briefly describe the publication policy of the facility:
All researchers are encouraged to publish results in peer-reviewed open literature. The NIH Public Access Policy (http://publicaccess.nih.gov/) ensures that the public has access to the published results of NIH funded research. It requires scientists to submit final peer-reviewed journal manuscripts that arise form

NIH funds to the National Library of Medicine's PubMed Central digital archive upon acceptance for publication. To help advance science and improve human health, the policy requires that these papers are accessible to the public on PubMed Central no later than 12 months after publication.

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Akkina R, Barber DL, Bility MT, Bissig KD, Burwitz BJ, Eichelberg K et al. Small Animal Models for Human Immunodeficiency Virus (HIV), Hepatitis B, and Tuberculosis: Proceedings of an NIAID Workshop. Curr HIV Res. 2019. doi:10.2174/1570162x18666191223114019. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.2174%2F1570162x18666191223114019
2. Altman MO, Angel M, Kosik I, Trovao NS, Zost SJ, Gibbs JS et al. Human Influenza A Virus Hemagglutinin Glycan Evolution Follows a Temporal Pattern to a Glycan Limit. mBio. 2019; 10(2). doi:10.1128/mBio.00204-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.00204-19
3. Amaral EP, Costa DL, Namasivayam S, Riteau N, Kamenyeva O, Mittereder L et al. A major role for ferroptosis in Mycobacterium tuberculosis-induced cell death and tissue necrosis. J Exp Med. 2019; 216(3): 556-570. doi:10.1084/jem.20181776. https://www.ncbi.nlm.nih.gov/pubmed/30787033
4. Angeletti D, Kosik I, Santos JJS, Yewdell WT, Boudreau CM, Mallajosyula VVA et al. Outflanking immunodominance to target subdominant broadly neutralizing epitopes. Proc Natl Acad Sci U S A. 2019; 116(27): 13474-13479. doi:10.1073/pnas.1816300116. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1073%2Fpnas.1816300116
5. Banks DA, Ahlbrand SE, Hughitt VK, Shah S, Mayer-Barber KD, Vogel SN et al. Mycobacterium tuberculosis Inhibits Autocrine Type I IFN Signaling to Increase Intracellular Survival. J Immunol. 2019; 202(8): 2348-2359. doi:10.4049/jimmunol.1801303. https://www.ncbi.nlm.nih.gov/pubmed/30833347
6. Barber DL, Sakai S, Kudchadkar RR, Fling SP, Day TA, Vergara JA et al. Tuberculosis following PD-1 blockade for cancer immunotherapy. Sci Transl Med. 2019; 11(475). doi:10.1126/scitranslmed.aat2702. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscitranslmed.aat2702
7. Beerli C, Yakimovich A, Kilcher S, Reynoso GV, Flaschner G, Muller DJ et al. Vaccinia virus hijacks EGFR signalling to enhance virus spread through rapid and directed infected cell motility. Nat Microbiol. 2019; 4(2): 216-225. doi:10.1038/s41564-018-0288-2. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41564-018-0288-2
8. Beites T, O'Brien K, Tiwari D, Engelhart CA, Walters S, Andrews J et al. Plasticity of the Mycobacterium tuberculosis respiratory chain and its impact on tuberculosis drug development. Nat Commun. 2019; 10(1): 4970. doi:10.1038/s41467-019-12956-2. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41467-019-12956-2
9. Campbell RA, Schwertz H, Hottz ED, Rowley JW, Manne BK, Washington AV et al. Human megakaryocytes possess intrinsic antiviral immunity through regulated induction of IFITM3. Blood. 2019; 133(19): 2013-2026. doi:10.1182/blood-2018-09-873984. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1182%2Fblood-2018-09-873984
10. Chea LS, Wyatt LS, Gangadhara S, Moss B, Amara RR. Novel Modified Vaccinia Virus Ankara Vector Expressing Anti-apoptotic Gene B13R Delays Apoptosis and Enhances Humoral Responses. J Virol. 2019; 93(5). doi:10.1128/jvi.01648-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.01648-18
11. Collins N, Han SJ, Enamorado M, Link VM, Huang B, Moseman EA et al. The Bone Marrow Protects and Optimizes Immunological Memory during Dietary Restriction. Cell. 2019;178(5): 1088-1101.e1015. doi:10.1016/j.cell.2019.07.049. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.cell.2019.07.049

12. Cowan JE, Malin J, Zhao Y, Seedhom MO, Harly C, Ohigashi I et al. Myc controls a distinct transcriptional program in fetal thymic epithelial cells that determines thymus growth. Nat Commun. 2019; 10(1): 5498. doi:10.1038/s41467-019-13465-y. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41467-019-13465-y
13. Cui X, Xu W, Neupane P, Weiser-Schlesinger A, Weng R, Pockros B et al. Bacillus anthracis lethal toxin, but not edema toxin, increases pulmonary artery pressure and permeability in isolated perfused rat lungs. Am J Physiol Heart Circ Physiol. 2019; 316(5): H1076-h1090. doi:10.1152/ajpheart.00685.2018. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1152%2Fajpheart.00685.2018
14. Daniel-Wayman S, Abate G, Barber DL, Bermudez LE, Coler RN, Cynamon MH et al. Advancing Translational Science for Pulmonary Nontuberculous Mycobacterial Infections. A Road Map for Research. Am J Respir Crit Care Med. 2019; 199(8): 947-951. doi:10.1164/rccm.201807-1273PP. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1164%2Frccm.201807-1273PP
15. Davis MJ, Moyer S, Hoke ES, Sionov E, Mayer-Barber KD, Barber DL et al. Pulmonary Iron Limitation Induced by Exogenous Type I IFN Protects Mice from Cryptococcus gattii Independently of T Cells. mBio. 2019; 10(3). doi:10.1128/mBio.00799-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.00799-19
16. Deplanche M, Mouhali N, Nguyen MT, Cauty C, Ezan F, Diot,A et al. Staphylococcus aureus induces DNA damage in host cell. Sci Rep. 2019; 9(1): 7694. doi:10.1038/s41598-019-44213-3. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41598-019-44213-3
17. De Rycker M, Horn D, Aldridge B, Amewu RK, Barry CE 3rd, Buckner FS et al. Setting Our Sights on Infectious Diseases. *ACS Infect Dis.* 2020 Jan 10;6(1):3-13. doi: 10.1021/acsinfecdis.9b00371. Epub 2019 Dec 6. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1021%2Facsinfecdis.9b00371
18. Dersh D, Yewdell JW, Wei J. A SIINFEKL-Based System to Measure MHC Class I Antigen Presentation Efficiency and Kinetics. Methods Mol Biol. 2019; 1988: 109-122. doi:10.1007/978-1-4939-9450-2_9. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2F978-1-4939-9450-2_9
19. Dheda K, Gumbo T, Maartens G, Dooley KE, Murray M, Furin J et al. The Lancet Respiratory Medicine Commission: 2019 update: epidemiology, pathogenesis, transmission, diagnosis, and management of multidrug-resistant and incurable tuberculosis. Lancet Respir Med. 2019; 7(9): 820-826. doi:10.1016/s2213-2600(19)30263-2. https://www.ncbi.nlm.nih.gov/pubmed/31486393
20. Diamond MS, Ledgerwood JE, Pierson TC. Zika Virus Vaccine Development: Progress in the Face of New Challenges. Annu Rev Med. 2019; 70: 121-135. doi:10.1146/annurev-med-040717-051127. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1146%2Fannurev-med-040717-051127
21. Dollery SJ, Santiago-Crespo RJ, Chatterjee D, Berger EA. Glycoprotein K8.1A of Kaposi's Sarcoma-Associated Herpesvirus Is a Critical B Cell Tropism Determinant Independent of Its Heparan Sulfate Binding Activity. J Virol. 2019; 93(6). doi:10.1128/jvi.01876-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.01876-18
22. Drummond RA, Swamydas M, Oikonomou V, Zhai B, Dambuza IM, Schaefer BC et al. CARD9(+) microglia promote antifungal immunity via IL-1beta- and CXCL1-mediated neutrophil recruitment. Nat Immunol. 2019; 20(5): 559-570. doi:10.1038/s41590-019-0377-2. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41590-019-0377-2
23. D'Souza MP, Adams E, Altman JD, Birnbaum ME, Boggiano C, Casorati G et al. Casting a wider net: Immunosurveillance by nonclassical MHC molecules. PLoS Pathog. 2019’ 15(2), e1007567. doi:10.1371/journal.ppat.1007567. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.ppat.1007567
24. Elvina Xavier MA, Liu S, Bugge TH, Torres JB, Mosley M, Hopkins SL et al. Tumor Imaging Using Radiolabeled Matrix Metalloproteinase-Activated Anthrax Proteins. J Nucl Med. 2019; 60(10): 1474-1482. doi:10.2967/jnumed.119.226423. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.2967%2Fjnumed.119.226423
25. Esteves PJ, Abrantes J, Baldauf HM, BenMohamed L, Chen Y, Christensen N et al. Author

Correction: The wide utility of rabbits as models of human diseases. Exp Mol Med. 2019; 51(7): 71. doi:10.1038/s12276-019-0252-0. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs12276-019-0252-0

26. Fauci A, Erbelding E, Whitehead S, Cassetti MC, Handley FG, Gupta R. Dengue vaccine clinical trials in India - An opportunity to inform the global response to a re-emerging disease challenge. Int J Infect Dis. 2019; 84s,:S4-s6. doi:10.1016/j.ijid.2019.03.016. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.ijid.2019.03.016
27. Fischer ES, Campbell WAt, Liu S, Ghirlando R, Fattah RJ, Bugge TH, Leppla SH. Bismaleimide cross-linked anthrax toxin forms functional octamers with high specificity in tumor targeting. Protein Sci. 2019; 28(6): 1059-1070. doi:10.1002/pro.3613. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1002%2Fpro.3613
28. Gao J, Couzens L, Burke DF, Wan H, Wilson P, Memoli MJ et al. Antigenic Drift of the Influenza A(H1N1)pdm09 Virus Neuraminidase Results in Reduced Effectiveness of A/California/7/2009 (H1N1pdm09)-Specific Antibodies. mBio. 2019; 10(2). doi:10.1128/mBio.00307-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.00307-19
29. Goo L, Debbink K, Kose N, Sapparapu G, Doyle MP, Wessel AW et al. A protective human monoclonal antibody targeting the West Nile virus E protein preferentially recognizes mature virions. Nat Microbiol. 2019; 4(1): 71-77. doi:10.1038/s41564-018-0283-7. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41564-018-0283-7
30. Han A, Czajkowski LM, Donaldson A, Baus HA, Reed SM, Athota RS et al. A Dose-finding Study of a Wild-type Influenza A(H3N2) Virus in a Healthy Volunteer Human Challenge Model. Clin Infect Dis. 2019; 69(12): 2082-2090. doi:10.1093/cid/ciz141. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Fcid%2Fciz141
31. Hardy BL, Dickey SW, Plaut RD, Riggins DP, Stibitz S, Otto M, Merrell DS. Corynebacterium pseudodiphtheriticum Exploits Staphylococcus aureus Virulence Components in a Novel Polymicrobial Defense Strategy. mBio. 2019; 10(1). doi:10.1128/mBio.02491-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02491-18
32. He L, Le KY, Khan BA, Nguyen TH, Hunt RL, Bae JS et al. Resistance to leukocytes ties benefits of quorum sensing dysfunctionality to biofilm infection. Nat Microbiol. 2019; 4(7): 1114-1119. doi:10.1038/s41564-019-0413-x. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41564-019-0413-x
33. Hickman HD. Slowing blood flow to fight viral infection. Science. 2019; 363(6427): 585-586. doi:10.1126/science.aaw3618. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscience.aaw3618
34. Hoft SG, Sallin MA, Kauffman KD, Sakai S, Ganusov VV, Barber DL. Erratum for Hoft et al., The Rate of CD4 T Cell Entry into the Lungs during Mycobacterium tuberculosis Infection Is Determined by Partial and Opposing Effects of Multiple Chemokine Receptors. Infect Immun. 2019; 87(9). doi:10.1128/iai.00491-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fiai.00491-19
35. Hoft SG, Sallin MA, Kauffman KD, Sakai S, Ganusov VV, Barber DL. The Rate of CD4 T Cell Entry into the Lungs during Mycobacterium tuberculosis Infection Is Determined by Partial and Opposing Effects of Multiple Chemokine Receptors. Infect Immun. 2019; 87(6). doi:10.1128/iai.00841-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fiai.00841-18
36. Hussain S, Turnbull ML, Wise HM, Jagger BW, Beard PM, Kovacikova K et al. Mutation of Influenza A Virus PA-X Decreases Pathogenicity in Chicken Embryos and Can Increase the Yield of Reassortant Candidate Vaccine Viruses. J Virol. 2019; 93(2). doi:10.1128/jvi.01551-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.01551-18
37. Jagger BW, Dowd KA, Chen RE, Desai P, Foreman B, Burgomaster KE et al. Protective Efficacy of Nucleic Acid Vaccines Against Transmission of Zika Virus During Pregnancy in Mice. J Infect Dis. 2019; 220(10): 1577-1588. doi:10.1093/infdis/jiz338. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiz338

38. Jegaskanda S, Andrews SF, Wheatley AK, Yewdell J W, McDermott AB, Subbarao K. Hemagglutinin head-specific responses dominate over stem-specific responses following prime boost with mismatched vaccines. JCI Insight. 2019; 4(22). doi:10.1172/jci.insight.129035. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1172%2Fjci.insight.129035
39. Johnson TP, Larman HB, Lee MH, Whitehead SS, Kowalak J, Toro C et al. Chronic Dengue Virus Panencephalitis in a Patient with Progressive Dementia with Extrapyramidal Features. Ann Neurol. 2019; 86(5): 695-703. doi:10.1002/ana.25588. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1002%2Fana.25588
40. Jones AT, Shen X, Walter KL, LaBranche CC, Wyatt LS, Tomaras GD et al. HIV-1 vaccination by needle-free oral injection induces strong mucosal immunity and protects against SHIV challenge. Nat Commun. 2019; 10(1): 798. doi:10.1038/s41467-019-08739-4. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41467-019-08739-4
41. Katsafanas GC, Moss B. Specific Anchoring and Local Translation of Poxviral ATI mRNA at Cytoplasmic Inclusion Bodies. J Virol. 2019. doi:10.1128/jvi.01671-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.01671-19
42. Khader SA, Divangahi M, Hanekom W, Hill PC, Maeurer M, Makar KW et al. Targeting innate immunity for tuberculosis vaccination. J Clin Invest. 2019; 129(9): 3482-3491. doi:10.1172/jci128877. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1172%2Fjci128877
43. Kosik I, Angeletti D, Gibbs JS, Angel M, Takeda K, Kosikova M et al. Neuraminidase inhibition contributes to influenza A virus neutralization by anti-hemagglutinin stem antibodies. J Exp Med. 2019; 216(2): 304-316. doi:10.1084/jem.20181624. https://www.ncbi.nlm.nih.gov/pubmed/30683737
44. Kosik I, Yewdell JW. Influenza Hemagglutinin and Neuraminidase: Yin(-)Yang Proteins Coevolving to Thwart Immunity. Viruses. 2019; 11(4). doi:10.3390/v11040346. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11040346
45. Krummel M, Blish C, Kuhns M, Cadwell K, Oberst A, Goldrath A et al. Universal Principled Review: A Community-Driven Method to Improve Peer Review. Cell. 2019; 179(7): 1441-1445. doi:10.1016/j.cell.2019.11.029. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.cell.2019.11.029
46. Kuskovsky R, Lloyd D, Arora K, Plotkin BJ, Green JM, Boshoff HI et al. C4-Phenylthio beta-lactams: Effect of the chirality of the beta-lactam ring on antimicrobial activity. Bioorg Med Chem. 2019; 27(20): 115050. doi:10.1016/j.bmc.2019.115050. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.bmc.2019.115050
47. Le KY, Villaruz AE, Zheng Y, He L, Fisher EL, Nguyen TH et al. Role of Phenol-Soluble Modulins in Staphylococcus epidermidis Biofilm Formation and Infection of Indwelling Medical Devices. J Mol Biol. 2019; 431(16): 3015-3027. doi:10.1016/j.jmb.2019.03.030. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.jmb.2019.03.030
48. Li G, Bos S, Tsetsarkin KA, Pletnev AG, Despres P, Gadea G, Zhao RY. The Roles of prM-E Proteins in Historical and Epidemic Zika Virus-mediated Infection and Neurocytotoxicity. Viruses. 2019; 11(2). doi:10.3390/v11020157. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.3390%2Fv11020157
49. Lins RC, Boyer AE, Kuklenyik Z, Woolfitt AR., Goldstein J, Hoffmaster AR et al. Zeptomole per milliliter detection and quantification of edema factor in plasma by LC-MS/MS yields insights into toxemia and the progression of inhalation anthrax. Anal Bioanal Chem. 2019; 411(12): 2493-2509. doi:10.1007/s00216-019-01730-4. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2Fs00216-019-01730-4
50. Liu R, Mendez-Rios JD, Peng C, Xiao W, Weisberg AS, Wyatt LS, Moss B. SPI-1 is a missing host-range factor required for replication of the attenuated modified vaccinia Ankara (MVA) vaccine vector in human cells. PLoS Pathog. 2019;15(5), e1007710. doi:10.1371/journal.ppat.1007710. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.ppat.1007710
51. Liu R, Olano LR, Mirzakhanyan Y, Gershon PD, Moss B. Vaccinia Virus Ankyrin-Repeat/F-Box

Protein Targets Interferon-Induced IFITs for Proteasomal Degradation. Cell Rep. 2019; 29(4): 816-828.e816. doi:10.1016/j.celrep.2019.09.039. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.celrep.2019.09.039

52. Liu Q, Liu Q, Meng H, Lv H, Liu Y, Liu J et al. Staphylococcus epidermidis Contributes to Healthy Maturation of the Nasal Microbiome by Stimulating Antimicrobial Peptide Production. Cell Host Microbe. 2019; 27(1): 68-78.e65. doi:10.1016/j.chom.2019.11.003. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.chom.2019.11.003
53. Malo CS, Hickman HD. Tracing Antiviral CD8(+) T Cell Responses Using In Vivo Imaging. J Immunol. 2019; 203(4): 775-781. doi:10.4049/jimmunol.1900232. https://www.ncbi.nlm.nih.gov/pubmed/31383748
54. Mathur A, Feng S, Hayward JA, Ngo C, Fox D, Atmosukarto II et al. A multicomponent toxin from Bacillus cereus incites inflammation and shapes host outcome via the NLRP3 inflammasome. Nat Microbiol. 2019; 4(2): 362-374. doi:10.1038/s41564-018-0318-0. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41564-018-0318-0
55. McCall RM, Sievers ME, Fattah R, Ghirlando R, Pomerantsev AP, Leppla SH. Bacillus anthracis Virulence Regulator AtxA Binds Specifically to the pagA Promoter Region. J Bacteriol. 2019; 201(23). doi:10.1128/jb.00569-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjb.00569-19
56. Memoli MJ, Han A, Walters KA, Czajkowski L, Reed S, Athota R et al. Influenza A Reinfection in Sequential Human Challenge: Implications for Protective Immunity and "Universal" Vaccine Development. Clin Infect Dis. 2019. doi:10.1093/cid/ciz281. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Fcid%2Fciz281
57. Momben Abolfath S, Kolberg,M, Karginov VA, Leppla SH, Nestorovich EM. Exploring the Nature of Cationic Blocker Recognition by the Anthrax Toxin Channel. Biophys J. 2019; 117(9): 1751-1763. doi:10.1016/j.bpj.2019.08.041. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.bpj.2019.08.041
58. Morens DM, Taubenberger JK. Making Universal Influenza Vaccines: Lessons From the 1918 Pandemic. J Infect Dis; 2019; 219(Supplement_1): S5-s13. doi:10.1093/infdis/jiy728. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiy728
59. Namasivayam S, Kauffman KD, McCulloch JA, Yuan W, Thovarai V, Mittereder LR et al. Correlation between Disease Severity and the Intestinal Microbiome in Mycobacterium tuberculosis-Infected Rhesus Macaques. mBio. 2019; 10(3). doi:10.1128/mBio.01018-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.01018-19
60. Nivarthi UK, Tu HA, Delacruz MJ, Swanstrom J, Patel B, Durbin AP et al. Longitudinal analysis of acute and convalescent B cell responses in a human primary dengue serotype 2 infection model. EBioMedicine. 2019; 41: 465-478. doi:10.1016/j.ebiom.2019.02.060. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.ebiom.2019.02.060
61. Oliveira-de-Souza D, Vinhaes CL, Arriaga MB, Kumar NP, Cubillos-Angulo JM, Shi R et al. Molecular degree of perturbation of plasma inflammatory markers associated with tuberculosis reveals distinct disease profiles between Indian and Chinese populations. Sci Rep. 2019; 9(1): 8002. doi:10.1038/s41598-019-44513-8. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41598-019-44513-8
62. Paliga D, Raudzus F, Leppla SH, Heumann R, Neumann S. Lethal Factor Domain-Mediated Delivery of Nurr1 Transcription Factor Enhances Tyrosine Hydroxylase Activity and Protects from Neurotoxin-Induced Degeneration of Dopaminergic Cells. Mol Neurobiol. 2019; 56(5): 3393-3403. doi:10.1007/s12035-018-1311-6. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2Fs12035-018-1311-6
63. Pampusch MS, Haran KP, Hart GT, Rakasz EG, Rendahl AK, Berger EA et al. Rapid Transduction and Expansion of Transduced T Cells with Maintenance of Central Memory Populations. Mol Ther Methods Clin Dev. 2019 Sep 30; 16:1-10. doi: 10.1016/j.omtm.2019.09.007. eCollection 2020 Mar

https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.omtm.2019.09.007

64. Park Y, Ahn YM, Jonnala S, Oh S, Fisher JM, Goodwin MB et al. Inhibition of CorA-Dependent Magnesium Homeostasis Is Cidal in Mycobacterium tuberculosis. Antimicrob Agents Chemother. 2019; 63(10). doi:10.1128/aac.01006-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Faac.01006-19
65. Parsons L, An Y, Qi L, White M, van der Woude R, Hartshorn K et al. Influenza Hemagglutinins H2, H5, H6, and H11 are not Targets of Pulmonary Surfactant Protein D: N-glycan subtypes in host-pathogen interactions. J Virol. 2019. doi:10.1128/jvi.01951-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.01951-19
66. Petermann F, Pekowska A, Johnson CA, Jankovic D, Shih HY, Jiang K et al. The Magnitude of IFN-gamma Responses Is Fine-Tuned by DNA Architecture and the Non-coding Transcript of Ifng-as1. Mol Cell. 2019; 75(6): 1229-1242.e1225. doi:10.1016/j.molcel.2019.06.025. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.molcel.2019.06.025
67. Petitdemange C, Kasturi SP, Kozlowski PA, Nabi R, Quarnstrom CF, Reddy PBJ et al. Vaccine induction of antibodies and tissue-resident CD8+ T cells enhances protection against mucosal SHIV-infection in young macaques. JCI Insight. 2019; 4(4). doi:10.1172/jci.insight.126047. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1172%2Fjci.insight.126047
68. Piewngam P, Otto M. Probiotics to prevent Staphylococcus aureus disease? Gut Microbes; 2020; 11(1):94-101. doi: 10.1080/19490976.2019.1591137. Epub 2019 Mar 26. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1080%2F19490976.2019.1591137
69. Piewngam P, Quinones M, Thirakittiwatthana W, Yungyuen T, Otto M, Kiratisin P. Composition of the intestinal microbiota in extended-spectrum beta-lactamase-producing Enterobacteriaceae carriers and non-carriers in Thailand. Int J Antimicrob Agents. 2019; 53(4): 435-441. doi:10.1016/j.ijantimicag.2018.12.006. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.ijantimicag.2018.12.006
70. Raafat D, Otto M, Reppschlager K, Iqbal J, Holtfreter S. Fighting Staphylococcus aureus Biofilms with Monoclonal Antibodies. Trends Microbiol. 2019; 27(4): 303-322. doi:10.1016/j.tim.2018.12.009. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.tim.2018.12.009
71. Reynoso GV, Shannon JP, Americo JL, Gibbs J, Hickman HD. Growth and Purification of Vaccinia Virus Stocks for MPM Imaging. Methods Mol Biol. 2019; 2023: 287-299. doi:10.1007/978-1-4939-9593-6_18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2F978-1-4939-9593-6_18
72. Reynoso GV, Weisberg AS, Shannon JP, McManus DT, Shores L, Americo JL, et al. Lymph node conduits transport virions for rapid T cell activation. Nat Immunol. 2019; 20(5): 602-612. doi: 10.1038/s41590-019-0342-0. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41590-019-0342-0
73. Salazar V, Jagger BW, Mongkolsapaya J, Burgomaster KE, Dejnirattisai W, Winkler ES et al. Dengue and Zika Virus Cross-Reactive Human Monoclonal Antibodies Protect against Spondweni Virus Infection and Pathogenesis in Mice. Cell Rep. 2019; 26(6): 1585-1597.e1584. doi:10.1016/j.celrep.2019.01.052. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.celrep.2019.01.052
74. Sardinha-Silva A, Mendonca-Natividade FC, Pinzan CF, Lopes CD, Costa DL, Jacot D et al. The lectin-specific activity of Toxoplasma gondii microneme proteins 1 and 4 binds Toll-like receptor 2 and 4 N-glycans to regulate innate immune priming. PLoS Pathog. 2019; 15(6), e1007871. doi:10.1371/journal.ppat.1007871. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.ppat.1007871
75. Shannon JP, Kamenyeva O, Reynoso GV, Hickman HD. Intravital Imaging of Vaccinia Virus-Infected Mice. Methods Mol Biol. 2019; 2023: 301-311. doi:10.1007/978-1-4939-9593-6_19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2F978-1-4939-9593-6_19
76. Sher A, Kelsall BL. The Colon as a Major Site of Immunoregulation by CD4(+) T Cell Subsets in the

Steady State. J Immunol. 2019; 203(7): 1683-1684. doi:10.4049/jimmunol.1900960. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.4049%2Fjimmunol.1900960

77. Silveira-Mattos PS, Narendran G, Akrami K, Fukutani KF, Anbalagan S, Nayak K et al. Author Correction: Differential expression of CXCR3 and CCR6 on CD4(+) T-lymphocytes with distinct memory phenotypes characterizes tuberculosis-associated immune reconstitution inflammatory syndrome. Sci Rep. 2019; 9(1): 8036. doi:10.1038/s41598-019-44429-3. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41598-019-44429-3
78. Silveira-Mattos PS, Narendran G, Akrami K, Fukutani KF, Anbalagan S, Nayak K et al. Differential expression of CXCR3 and CCR6 on CD4(+) T-lymphocytes with distinct memory phenotypes characterizes tuberculosis-associated immune reconstitution inflammatory syndrome. Sci Rep. 2019; 9(1): 1502. doi:10.1038/s41598-018-37846-3. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41598-018-37846-3
79. Singhania A, Graham CM, Gabrysova L, Moreira-Teixeira L, Stavropoulos E, Pitt JM et al. Transcriptional profiling unveils type I and II interferon networks in blood and tissues across diseases. Nat Commun. 2019; 10(1): 2887. doi:10.1038/s41467-019-10601-6. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41467-019-10601-6
80. Stifter SA, Bhattacharyya N, Sawyer AJ, Cootes TA, Stambas J, Doyle SE et al. Visualizing the Selectivity and Dynamics of Interferon Signaling In Vivo. Cell Rep. 2019; 29(11): 3539-3550.e3534. doi:10.1016/j.celrep.2019.11.021. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.celrep.2019.11.021
81. Strydom N, Gupta SV, Fox WS, Via LE. Bang H, Lee M et al. Tuberculosis drugs' distribution and emergence of resistance in patient's lung lesions: A mechanistic model and tool for regimen and dose optimization. PLoS Med. 2019; 16(4): e1002773. doi:10.1371/journal.pmed.1002773. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1371%2Fjournal.pmed.1002773
82. Swanstrom JA, Nivarthi UK, Patel B, Delacruz MJ, Yount B, Widman DG et al. Beyond Neutralizing Antibody Levels: The Epitope Specificity of Antibodies Induced by National Institutes of Health Monovalent Dengue Virus Vaccines. J Infect Dis. 2019; 220(2): 219-227. doi:10.1093/infdis/jiz109. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Finfdis%2Fjiz109
83. Tan HX, Jegaskanda S, Juno JA, Esterbauer R, Wong J, Kelly HG et al. Subdominance and poor intrinsic immunogenicity limit humoral immunity targeting influenza HA stem. J Clin Invest. 2019; 129(2): 850-862. doi:10.1172/jci123366. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1172%2Fjci123366
84. Taubenberger JK. Influenza's Newest Trick. mBio. 2019; 10(6). doi:10.1128/mBio.02854-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02854-19
85. Taubenberger JK, Kash JC, Morens DM. The 1918 influenza pandemic: 100 years of questions answered and unanswered. Sci Transl Med. 2019; 11(502). doi:10.1126/scitranslmed.aau5485. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscitranslmed.aau5485
86. Taubenberger JK, Morens DM. The 1918 Influenza Pandemic and Its Legacy. Cold Spring Harb Perspect Med. 2019. doi:10.1101/cshperspect.a038695. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1101%2Fcshperspect.a038695
87. Tsetsarkin KA, Maximova OA, Liu G, Kenney H, Teterina NL, Pletnev AG. Stable and Highly Immunogenic MicroRNA-Targeted Single-Dose Live Attenuated Vaccine Candidate against Tick-Borne Encephalitis Constructed Using Genetic Backbone of Langat Virus. mBio. 2019; 10(2). doi:10.1128/mBio.02904-18. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02904-18
88. Van Rompay KKA, Keesler RI, Ardeshir A, Watanabe J, Usachenko J, Singapuri A et al. DNA vaccination before conception protects Zika virus-exposed pregnant macaques against prolonged viremia and improves fetal outcomes. Sci Transl Med. 2019; 11(523). doi:10.1126/scitranslmed.aay2736. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1126%2Fscitranslmed.aay2736

89. Vinhaes CL, Oliveira-de-Souza D, Silveira-Mattos PS, Nogueira B, Shi R, Wei W et al. Changes in inflammatory protein and lipid mediator profiles persist after antitubercular treatment of pulmonary and extrapulmonary tuberculosis: A prospective cohort study. Cytokine. 2019; 123: 154759. doi:10.1016/j.cyto.2019.154759. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.cyto.2019.154759
90. Vinton CL, Magaziner SJ, Dowd KA, Robertson SJ, Amaro-Carambot E, Karmele EP et al. Simian Immunodeficiency Virus Infection of Rhesus Macaques Results in Delayed Zika Virus Clearance. mBio. 2019; 10(6). doi:10.1128/mBio.02790-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.02790-19
91. Vrentas CE, Boggiatto PM, Olsen SC, Leppla SH, Moayeri M. Characterization of the NLRP1 inflammasome response in bovine species. Innate Immun. 2019; 1753425919886649. doi:10.1177/1753425919886649. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1177%2F1753425919886649
92. Walters KA, Zhu R, Welge M, Scherler K, Park JK, Rahil Z et al. Differential Effects of Influenza Virus NA, HA Head, and HA Stalk Antibodies on Peripheral Blood Leukocyte Gene Expression during Human Infection. mBio. 2019; 10(3). doi:10.1128/mBio.00760-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2FmBio.00760-19
93. Wang L, Xu Y, Rogers H, Saidi L, Noguchi CT, Li,H et al. UFMylation of RPL26 links translocation-associated quality control to endoplasmic reticulum protein homeostasis. Cell Res. 2020 Jan; 30(1):5-20. doi: 10.1038/s41422-019-0236-6. Epub 2019 Oct 8. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fs41422-019-0236-6
94. Wang Z, Soni V, Marrine, G, Kaneko T, Boshoff HIM, Barry CE 3rd, Rhee KY. Mode-of-action profiling reveals glutamine synthetase as a collateral metabolic vulnerability of M. tuberculosis to bedaquiline. Proc Natl Acad Sci U S A. 2019; 116(39): 19646-19651. doi:10.1073/pnas.1907946116. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1073%2Fpnas.1907946116
95. Wasserman S, Louw G, Ramangoaela L, Barber G, Hayes C, Omar SV et al. Linezolid resistance in patients with drug-resistant TB and treatment failure in South Africa. J Antimicrob Chemother. 2019; 74(8): 2377-2384. doi:10.1093/jac/dkz206. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1093%2Fjac%2Fdkz206
96. Wei J, Kishton RJ, Angel M, Conn CS, Dalla-Venezia N, Marcel V et al. Ribosomal Proteins Regulate MHC Class I Peptide Generation for Immunosurveillance. Mol Cell. 2019; 73(6): 1162-1173.e1165. doi:10.1016/j.molcel.2018.12.020. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.molcel.2018.12.020
97. Wei J, Yewdell JW. Flu DRiPs in MHC Class I Immunosurveillance. Virol Sin. 2019; 34(2): 162-167. doi:10.1007/s12250-018-0061-y. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1007%2Fs12250-018-0061-y
98. Wei J, Yewdell JW. Immunoribosomes: Where's there's fire, there's fire. Mol Immunol. 2019; 113: 38-42. doi:10.1016/j.molimm.2017.12.026. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.molimm.2017.12.026
99. Whitehead SS, Pierson TC. Effects of dengue immunity on Zika virus infection. Nature. 2019; 567(7749): 467-468. doi:10.1038/d41586-019-00868-6. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1038%2Fd41586-019-00868-6
100. Whitehouse AJ, Libardo MDJ, Kasbekar M, Brear PD, Fischer G, Thomas CJ et al. Targeting of Fumarate Hydratase from Mycobacterium tuberculosis Using Allosteric Inhibitors with a Dimeric-Binding Mode. J Med Chem. 2019; 62(23), 10586-10604. doi:10.1021/acs.jmedchem.9b01203. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1021%2Facs.jmedchem.9b01203
101. Xavier ME, Liu S, Leppla SH, Cornelissen B. Pre-labelling versus direct labelling of anthrax proteins for imaging of matrix metalloproteinases activity using DOTA-GA. Nucl Med Biol. 2019; 72-73: 49-54. doi:10.1016/j.nucmedbio.2019.07.007. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.nucmedbio.2019.07.007

102. Xiao Y, Park JK, Williams S, Ramuta M, Cervantes-Medina A, Bristol T et al. Deep sequencing of 2009 influenza A/H1N1 virus isolated from volunteer human challenge study participants and natural infections. Virology. 2019; 534: 96-107. doi:10.1016/j.virol.2019.06.004. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.virol.2019.06.004
103. Yewdell JW, Dersh D, Fahraeus R. Peptide Channeling: The Key to MHC Class I Immunosurveillance? Trends Cell Biol. 2019; 29(12): 929-939. doi:10.1016/j.tcb.2019.09.004. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1016%2Fj.tcb.2019.09.004
104. Zanker DJ, Oveissi S, Tscharke DC, Duan M, Wan S, Zhang X et al. Influenza A Virus Infection Induces Viral and Cellular Defective Ribosomal Products Encoded by Alternative Reading Frames. J Immunol. 2019; 202(12): 3370-3380. doi:10.4049/jimmunol.1900070. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.4049%2Fjimmunol.1900070

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: At the C.W. Bill Young Center for Biodefense and Emerging Infectious Diseases, the Laboratory of Infectious Diseases (LID) focuses on vaccine development, host immune response to viruses, and viral molecular biology and genetics. The Laboratory of Parasitic Diseases (LPD) conducts basic and applied research on the prevention, control, and treatment of a variety of parasitic and bacterial diseases of global importance. The Laboratory of Viral Diseases (LVD) carries out investigations on the molecular biology of viruses, the interactions of viruses with host cells, the pathogens of viral diseases, and host defense mechanisms. The Laboratory of Clinical Immunology and Microbiology (LCIM) conducts clinical and basic science, and epidemiologic research into human immunologic, inflammatory, and infectious diseases. More information can be found at http://www.nih.gov/news-events/news-releases/nih-dedicates-cw-bill-young-center-biodefense-emerging-infectious-diseases.

Microorganisms and/or toxins studied: Select Agents (HHS, USDA) and Toxin (HHS), NIAID Category A pathogen

Outdoor studies: No outdoor studies of biological aerosols were conducted.

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[*] Including viruses and prions.

National biological defence research and development programmes

1. What is the name of the facility?
Dale and Betty Bumpers Vaccine Research Center (VRC)

2. Where is it located (include both address and geographical location)?
9000 Rockville Pike, Bethesda, Maryland 20892

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	104m^2
BSL-3	0m^2
BSL-4	0m^2
Total laboratory floor area	104 m^2

4. The organizational structure of each facility.

(i)	**Total number of personnel**	13
(ii)	**Division of personnel**:	
	Military	0
	Civilian	13
(iii)	**Division of personnel by category**:	
	Scientists	13
	Engineers	0
	Technicians	0
	Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff.
Biological Science

(v) Are contractor staff working in the facility? If so, provide an approximate number.
Yes Number: 7

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
Department of Health and Human Services (HHS)

(vii) What are the funding levels for the following programme areas:

Research	$1,468,352
Development	$0
Test and evaluation	$0
Total	$1,468,352

(viii) Briefly describe the publication policy of the facility:
All researchers are encouraged to publish results in peer-reviewed open literature. The NIH Public Access Policy (http://publicaccess.nih.gov/) ensures that the public has access to the published results of NIH funded research. It requires scientists to submit final peer-reviewed journal manuscripts that arise form

NIH funds to the National Library of Medicine's PubMed Central digital archive upon acceptance for publication. To help advance science and improve human health, the policy requires that these papers are accessible to the public on PubMed Central no later than 12 months after publication.

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Gaudinski MR, Coates EE, Novik L, Widge A, Houser KV, Burch E et al. Safety, tolerability, pharmacokinetics, and immunogenicity of the therapeutic monoclonal antibody mAb114 targeting Ebola virus glycoprotein (VRC 608): an open-label phase 1 study. Lancet. 2019; 393(10174): 889-898. doi:10.1016/s0140-6736(19)30036-4. https://www.ncbi.nlm.nih.gov/pubmed/30686586
2. Sutton MS, Ellis-Connell A, Balgeman AJ, Barry G, Weiler AM, Hetzel SJ et al. CD8beta Depletion Does Not Prevent Control of Viral Replication or Protection from Challenge in Macaques Chronically Infected with a Live Attenuated Simian Immunodeficiency Virus. J Virol. 2019; 93(15). doi:10.1128/jvi.00537-19. https://www.ncbi.nlm.nih.gov/pubmed/?term=10.1128%2Fjvi.00537-19

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: The mission of the Vaccine Research Center (VRC) is to conduct research that facilitates the development of effective vaccines for human disease. The research focus of the Biodefense Research Section comprises three areas: development of vaccines and antivirals against hemorrhagic fever viruses such as Ebola, Marburg, and Lassa; studies of the mechanism of vaccine-induced immune protection and host immunity to natural infection; basic research to understand the mechanism of virus replication (entry) and neutralization.

Microorganisms and/or toxins studied: No U.S. Select Agents, NIAID Category A pathogens, or applicable simulants were used.

Outdoor studies: No outdoor studies of biological aerosols were conducted.

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[*] Including viruse and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Foreign Disease-Weed Science Research Unit

2. Where is it located (provide both address and geographical location)?
1301 Ditto Avenue, Fort Detrick, Maryland 21702

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	105 m^2
BSL-3:	950 m^2
BSL-4:	0 m^2
Total laboratory floor area:	1,055 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	36

(ii)	**Division of personnel:**	
	Military	0
	Civilian	36

(iii)	**Division of personnel by category:**	
	Scientists	11
	Engineers	0
	Technicians	15
	Administrative and support staff	10

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Agronomy, Biological Science, Genomics, Horticulture, Bacteriology, Microbial Forensics, Molecular Diagnostics, Plant Biochemistry, Plant Molecular Biology, Plant Pathology, Plant Physiology, Proteomics, Virology, Weed Science

(v) Are contractor staff working in the facility? If so, provide an approximate number:
No

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Agriculture (USDA)

(vii) What are the funding levels for the following program areas:

Research	$4,000,000
Development	$0
Test and evaluation	$0
Total	$4,000,000

(viii) Briefly describe the publication policy of the facility:

All scientific research data is available for publication in peer-reviewed publications after review for dual use determination. All scientists are required to have a minimum of two peer-reviewed publications per year (not all publications by these scientists are relevant to this report). They are encouraged to present research at scientific conferences and to publish in books and proceedings. The USDA Agricultural Research Service (ARS) maintains a searchable online database of publications by scientists at this location (available at https://www.ars.usda.gov/research/publications/publications-at-this-location/?modeCode=80-44-05-00.)

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

None published in CY2019

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

***Objectives*:** The Foreign Disease-Weed Science Research Unit has two distinct missions united by a common relationship to plant pathology and the unit's BL-3 plant pathogen laboratory and greenhouse containment facilities. 1) The mission of the foreign disease program is to develop techniques for the rapid detection and identification of new and emerging crop pathogens, and to provide fundamental information on emerging pathogens for risk assessment and the development of practical phytosanitary regulations for the import and export of agricultural commodities and germplasm. 2) The mission of the weed biological control program is to collect foreign pathogens overseas from weeds in their native habitat, and to evaluate, characterize and release the pathogens in the U.S. for biological control of introduced weeds, leading to improved, sustainable weed control practices in agricultural systems with reduced dependence on chemical herbicides. Additional information about research projects conducted at this location is available at http://www.ars.usda.gov/research/projects_programs.htm?modecode=80-44-05-00.

***Microorganisms and/or Toxins Studied*:** Select Agents (Plant Protection and Quarantine, PPQ).

***Outdoor Studies*:** No research work is done outdoors with infectious organisms.

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[*] Including viruses and prions.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
National Animal Disease Center (NADC)

2. Where is it located (provide both address and geographical location)?
1920 Dayton Avenue, Ames, Iowa 50010

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	4,410 m^2
BSL-3:	2,489 m^2
BSL-4:	0 m^2
Total laboratory floor area:	6,899 m^2

In addition, NADC has unique animal biocontainment facilities ranging from ABSL-2 to ABSL-3Ag (highest biocontainment level that can accommodate food producing animals and various wildlife species). Biocontainment enhancements include HEPA-filtered supply air; dual HEPA filtered exhaust; air-tight doors; shower-in/out of each animal room; heat-treated waste; steam-treated rendering for carcasses; stainless steel penning and gating systems; epoxy-coated floors; and epoxy-covered surfaces. NADC also has two large biocontainment buildings that are considered ABSL-2-enhanced.

ABSL-2:	3,467.7 m^2
ABSL-3:	160.5 m^2
ABSL-3Ag:	1,581.6 m^2
Total biocontainment facility floor area:	5209.8 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	4
(ii)	**Division of personnel:**	
	Military	0
	Civilian	4
(iii)	**Division of personnel by category:**	
	Scientists	2
	Engineers	0
	Technicians	1
	Administrative and support staff	1

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Immunology, Infectious Disease, Molecular Biology, Pathology, Vaccinology and Veterinary Medicine

(v) Are contractor staff working in the facility? If so, provide an approximate number:
No

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Agriculture (USDA)

(vii) What are the funding levels for the following program areas:

Research	$5,900,000
Development	$0
Test and evaluation	$0
Total	$5,900,000

(viii) Briefly describe the publication policy of the facility:

All scientific research data is available for publication in peer-reviewed publications after review for dual use determination. All scientists are required to have a minimum of two peer-reviewed publications per year (not all publications by these scientists are relevant to this report). They are encouraged to present research at scientific conferences and to publish in books and proceedings. The USDA Agricultural Research Service (ARS) maintains a searchable online database of publications by scientists at this location (available at https://www.ars.usda.gov/research/publications/publications-at-this-location/?modeCode=50-30-20-00.)

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Boggiatto, PM, Olsen, SC. Tulathromycin treatment does not affect bacterial dissemination or clearance of *Brucella melitensis* 16M following experimental infection of goats. PLoS One. 2019; 14(12):e0226242. http://dx.doi.org/10.1371/journal.pone.0226242.
2. Boggiatto, PM, Schaut, RG, Kanipe, C, Kelly, SM, Narasimhan, B, Jones, DE, et al. Sustained antigen release polyanhydride-based vaccine platform for immunization against bovine brucellosis. Heliyon. 2019; 5(8)e02370. http://dx.doi.org/10.1016/j.heliyon.2019.e02370.
3. Lindahl, J.F, Vrentas, CE, Deka, RP, Hazarika, RA, Rahman, H, Bambal, RG, et al. Brucellosis in India: results of a collaborative workshop to define One Health priorities. 2019. Trop Anim Health Prod. 52(1):387-396. http://dx.doi.org/10.1007/s11250-019-02029-3.

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

Objectives: Support the control and eradication of national and international exotic, emerging, zoonotic, and endemic infectious diseases of animals through a comprehensive research program emphasizing basic and applied research in diagnostics, prevention, and control strategies, prediction of disease outbreaks, molecular epidemiology, and understanding disease pathogenesis. Specifically, the research programs aim to produce new research knowledge and technology to: prevent, reduce or eliminate losses from impaired livestock performance,increased deaths, or condemnations; develop more sensitive, specific and rapid diagnostic tests; develop vaccines designed for the control and, when feasible, the eradication of disease; improve our understanding of the ecology and epidemiology of pathogens at the domestic animal-wildlife interface; and improve our understanding of the genetic and pathophysiologic basis of disease and pathogen virulence. This research provides government regulatory agencies and the livestock industries with improved intervention strategies against priority diseases. Additional information about research projects conducted at this location is available at http://www.ars.usda.gov/research/projects_programs.htm?modecode=50-30-20-00.

Microorganisms and/or Toxins Studied: Overlap Select Agents

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[*] Including viruses and prions.

***Outdoor Studies*:** No research work is done outdoors with infectious organisms.

National biological defence research and development programmes: Facilities

1. What is the name of the facility?
Southeast Poultry Research Laboratory

2. Where is it located (provide both address and geographical location)?
934 College Station Road, Athens, Georgia 30605

3. Floor area of laboratory areas by containment level (m^2):

BSL-2:	1,138 m^2
BSL-3:	624 m^2
BSL-4:	0 m^2
Total laboratory floor area:	1,762 m^2

4. The organizational structure of each facility:

(i)	**Total number of personnel:**	31
(ii)	**Division of personnel:**	
	Military	0
	Civilian	31
(iii)	**Division of personnel by category:**	
	Scientists	7
	Engineers	0
	Technicians	3
	Administrative and support staff	21

(iv) List the scientific disciplines represented in the scientific/engineering staff:
Animal Science, Bioinformatics, Biological Science, Biotechnology, Cell Biology, Computational Biology, Epidemiology, Genetics, Genomics, Immunology, Microbiology, Molecular Biology, Molecular Diagnostics, Pathology, Public Health, Vaccinology, Veterinary Medicine, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number:
No

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
U.S. Department of Agriculture (USDA)
Department of Health and Human Services (HHS)
Department of Defense (DoD) – Partly
Non-Profit Associations
Private Sector Companies
Department of State

(vii) What are the funding levels for the following program areas:

Research	$4,600,000
Development	$0

Test and evaluation	$0
Total	$4,600,000

(viii) Briefly describe the publication policy of the facility:

All scientific research data is available for publication in peer-reviewed publications after review for dual use determination. All scientists are required to have a minimum of two peer-reviewed publications per year (not all publications by these scientists are relevant to this report). They are encouraged to present research at scientific conferences and to publish in books and proceedings. The USDA Agricultural Research Service (ARS) maintains a searchable online database of publications by scientists at this location (available at https://www.ars.usda.gov/research/publications/publications-at-this-location/?modeCode=60-40-10-30.)

(ix) Provide a list of publicly-available papers and reports resulting from the work during the previous 12 months. (To include authors, titles, and full references.):

1. Andreychuk, DB, Andriyasov, AV, Nikonova, ZB., Kozlov, AA, Suarez, DL. Armoured exogenous internal control for real-time PCR diagnosis of avian influenza. Avian Pathol. 2019; 48(5):492-498 https://doi.org/10.1080/03079457.2019.1628918
2. Ayala, AJ, Hernandez, SM, Olivier, TL, Welch, CN, Dimitrov, KM, Goraichuk, et al. Experimental Infection and Transmission of Newcastle Disease Vaccine Virus in Four Wild Passerines. Avian Dis. 2019; 63(3): 389-399. https://doi.org/10.1637/11980-092918-Reg.1
3. Butt, SL, Dimitrov, KM, Zhang, J, Wajid, A, Bibi, T, Basharat, A, et al. Enhanced phylogenetic resolution of Newcastle disease outbreaks using complete viral genome sequences from formalin-fixed paraffin-embedded tissue samples. Virus Genes. 2019; 55(4):505-512. https://doi.org/10.1007/s11262-019-01669-9
4. Carnaccini, S, Santos, JJ, Obadan, AO, Pantin Jackwood, MJ, Suarez, DL, Rajão, DS, et al. 2019. Age-dependent pathogenesis of clade 2.3.4.4A H5N2 HPAIV in experimentally infected broad breasted white turkeys. Vet Microbiol. 231:183-190. https://doi.org/10.1016/j.vetmic.2019.03.011
5. Criado, MF, Bertran, K, Lee, D, Killmaster, L, Stephens, CB, Spackman, E, et al. Efficacy of novel recombinant fowlpox vaccine against recent Mexican H7N3 highly pathogenic avian influenza virus. Vaccine. 2019; 37(16):2232-2243. https://doi.org/10.1016/j.vaccine.2019.03.009
6. Dimitrov, KM, Abolnik, C, Afonso, CL, Albina, E, Bahl, J, Berg, M, et al. Updated unified phylogenetic classification system and revised nomenclature for Newcastle disease virus. Infect Genet Evol. 2019; 74:103917. https://doi.org/10.1016/j.meegid.2019.103917
7. Dimitrov, KM, Ferreira, HL, Pantin-Jackwood, MJ, Taylor, TL, Goraichuk, IV, Crossley, BM, et al. Pathogenicity and transmission of virulent Newcastle disease virus from the 2018-2019 California outbreak and related viruses in young and adult chickens. Virology. 2019; 531:203-218. https://doi.org/10.1016/j.virol.2019.03.010
8. Ferreira, H, Suarez, DL. Single-nucleotide polymorphism analysis to select conserved regions for an improved real-time reverse transcription-PCR test specific for Newcastle Disease Virus. Avian Dis. 2019; 63(4):625-633. https://doi.org/10.1637/aviandiseases-D-19-00071
9. Ferreira, HL, Taylor, TL, Absalon, AE, Dimitrov, KM, Cortes-Espinosa, DV, Butt, SL, et al. Presence of Newcastle disease viruses of sub-genotypes Vc and VIn in backyard chickens and in apparently healthy wild birds from Mexico in 2017. Virus Genes. 2019; 55(4):479-489. https://doi.org/10.1007/s11262-019-01663-1
10. Ferreira, HL, Taylor, TL, Dimitrov, KM, Sabra, M., Afonso, CL, Suarez, DL. Virulent Newcastle disease viruses from chicken origin are more pathogenic and transmissible to chickens than viruses normally maintained in wild birds. Vet Microbiol. 2019; 235:25-34. https://doi.org/10.1016/j.vetmic.2019.06.004

11. Goraichuk, IV, Msoffe, PL, Chiwanga, GH, Dimitrov, KM, Afonso, CL, Suarez, DL. First complete genome sequences of a subgenotype Vd Newcastle disease virus isolate. Microbiol Resour Announc. 2019; 8(27):e00436-19. https://doi.org/10.1128/MRA.00436-19
12. Lee, D, Killian, ML, Torchetti, MK, Brown, I, Lewis, N, Berhane, Y, et al. Intercontinental spread of Asian-origin H7 avian influenza viruses by captive bird trade in 1990`s. Infect Genet Evol. 2019: 73:146-150. https://doi.org/10.1016/j.meegid.2019.04.028
13. Msoffe, PL, Chiwanga, GH, Cardona, CJ, Miller, PJ, Suarez, DL. Isolation and Characterization of Newcastle Disease Virus from Live Bird Markets in Tanzania. Avian Dis. 2019; 63 (4):634-640. https://doi.org/10.1637/aviandiseases-D-19-00089
14. Muzyka, D, Rula, O, Tkachenko, S, Muzyka, N, Kothe, S, Pishchanskyi, O, et al. Highly pathogenic and low pathogenic avian influenza H5 subtype viruses in wild birds in Ukraine. Avian Dis. 2019; 63(sp1):235-245. https://doi.org/10.1637/11879-042718-ResNote.1
15. Ross, TM, DiNapoli, J, Giel-Moloney, M, Bloom, CE, Bertran, K, Balzli, C, et al. A computationally designed H5 antigen shows immunological breadth of coverage and protects against drifting avian strains. Proc Natl Acad Sci. 2019; 37:2369-2376. https://doi.org/10.1016/j.vaccine.2019.03.018
16. Spackman, E, Malladi, S, Ssematimba, A, Stephens, CB. Assessment of replicate numbers for titrating avian influenza virus using dose-response models. J Vet Diagn Invest. 2019; 31(4):616-619. https://doi.org/10.1177/1040638719853851
17. Stephens, CB, Prosser, DJ, Pantin-Jackwood, MJ, Berlin, AM, Spackman, E. The pathogenesis of H7 highly pathogenic avian influenza viruses in Lesser Scaup (Aythya affinis). Avian Dis. 2019; 63(sp1):230-234. https://doi.org/10.1637/11909-060118-ResNote.1
18. Ssematimba, A, Malladi, S, Hagenaars, TJ, Bonney, PJ, Weaver, JT, Patyk, KA, et al. Estimating within-flock transmission rate parameter for H5N2 highly pathogenic avian influenza virus in Minnesota turkey flocks during the 2015 epizootic. Epidemiol Infect. 2019; 147:e179. https://doi.org/10.1017/S0950268819000633
19. Welch, CN, Shittu, I, Abolnik, C, Ponman, S, Dimitrov, KM, Taylor, TL, et al. Genomic comparison of Newcastle disease viruses isolated in Nigeria between 2002 and 2015 reveals circulation of highly diverse genotypes and spillover into wild birds. Arch Virol. 2019; 164(8):2031-2047. https://doi.org/10.1007/s00705-019-04288-9
20. Youk, S, Lee, D, Ferreira, HL, Afonso, CL, Absalon, AE, Swayne, DE, et al. Rapid evolution of Mexican H7N3 highly pathogenic avian influenza viruses in poultry. PLoS One. 2019; 14(9):e0222457. https://doi.org/10.1371/journal.pone.0222457
21. Youk, S, Lee, D, Leyson, CM, Smith, D, Criado, MF, DeJesus, E, et al. Loss of fitness of Mexican H7N3 highly pathogenic avian influenza virus in mallards after circulating in chickens. J Virol. 2019; 93(14):e00543-19. https://doi.org/10.1128/JVI.00543-19

5. Briefly describe the biological defence work carried out at the facility, including type(s) of microorganisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols:

Objectives: Provide scientific solutions to national and international exotic, emerging and endemic poultry viral diseases through a comprehensive research program emphasizing basic and applied research in diagnostics, prevention, and control strategies; prediction of disease outbreaks; molecular epidemiology; and understanding of disease pathogenesis. Produce new research knowledge and technology to: prevent, reduce or eliminate losses from impaired poultry livestock performance, increased deaths, or condemnations; develop more sensitive, specific and rapid diagnostic tests; develop vaccines designed for the control and, when feasible, the eradication of disease; improve our understanding of the ecology and epidemiology of viruses at the wild bird-domestic poultry interface; and improve our understanding of the genetic and pathobiological basis of virulence. This research provides government regulatory agencies and the poultry industries with improved intervention strategies against poultry viral diseases. The Laboratory has one research unit that conducts biological defense work: Exotic and Emerging Avian Viral Diseases Research Unit. Additional information about research projects conducted at this location is available at http://www.ars.usda.gov/main/site_main.htm?modecode=60-40-10-00.

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[*] Including viruses and prions.

Microorganisms and/or Toxins Studied**:** Select Agents (USDA).

Outdoor Studies**:** No research work is done outdoors with infectious organisms.

National biological defence research and development programmes

1. What is the name of the facility?
Food and Drug Administration White Oak Campus

Note: This facility includes the Center for Biologics Evaluation and Research (CBER) and the Center for Drug Evaluation and Research (CDER). Inclusion of the CDER is an addition in the 2019 CBM report.

2. Where is it located (include both address and geographical location)?
10903 New Hampshire Avenue, Silver Spring, MD 20993

3. Floor area of laboratory areas by containment level (m^2):

BSL-2	418 m^2
BSL-3	184 m^2
BSL-4	0 m^2
Total laboratory floor area	602 m^2

Note: The BSL-2 laboratory area for this facility includes the total area, including area that is used for research and development unrelated to biological defense.

4. The organizational structure of each facility.

(i) Total number of personnel	71

(ii) Division of personnel:

Military	0
Civilian	71

(iii) Division of personnel by category:

Scientists	51
Engineers	0
Technicians	0
Administrative and support staff	20

(iv) List the scientific disciplines represented in the scientific/engineering staff.
Bacteriology, Biological Science, Biomedical Science, Biotechnology, Biochemistry, Cell Biology, Genetics, Immunology, Microbiology, Molecular Biology, Molecular Diagnostics, Nanotechnology, Virology

(v) Are contractor staff working in the facility? If so, provide an approximate number.
Yes Number: 6

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
Department of Health and Human Services (HHS)

(vii) What are the funding levels for the following programme areas:

Research	$918,315

Development	$0
Test and evaluation	$0
Total	$918,315

(viii) Briefly describe the publication policy of the facility:
FDA staff are encouraged to publish their research results in peer-reviewed scientific journals. The FDA review and clearance policy ensures publications are of high quality and vetted by subject matter experts as well as leadership. In addition, compliance with the public access to federally-funded scientific research (including digital data and publications) is assured by following FDA's data management plan. The policy states that publications must be uploaded to PubMed Central one year after the publication date. Each medical product Center may also have an additional review and clearance policy.

- FDA review and clearance policy: https://www.fda.gov/media/80061/download
- CDER review and clearance policy: https://www.fda.gov/media/72538/download
- FDA Data Management Plan: http://www.fda.gov/downloads/AboutFDA/ReportsManualsForms/StaffManualGuides/UCM479268.pdf

(ix) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Adams SE, Lee N, Lugovtsev VY, Kan A, Donnelly RP, Ilyushina NA. Effect of influenza H1N1 neuraminidase V116A and I117V mutations on NA activity and sensitivity to NA inhibitors. Antiviral Res. 2019; 169:104539. doi: 10.1016/j.antiviral.2019.104539. https://www.ncbi.nlm.nih.gov/pubmed/31228489
2. Ilyushina NA, Dickensheets H, Donnelly RP. A comparison of interferon gene expression induced by influenza A virus infection of human airway epithelial cells from two different donors. Virus Research. 2019; 264:1-7. doi: 10.1016/j.virusres.2019.02.002. https://www.ncbi.nlm.nih.gov/pubmed/30779949/
3. Ilyushina NA, Komatsu TE, Ince WL, Donaldson EF, Lee N, O'Rear JJ et al. Influenza A virus hemagglutinin mutations associated with use of neuraminidase inhibitors correlate with decreased inhibition by anti-influenza antibodies. Virol J. 2019; 16(1):149. doi: 10.1186/s12985-019-1258-x. https://www.ncbi.nlm.nih.gov/pubmed/31783761
4. McWilliams IL, Kielczewski JL, Ireland DDC, Sykes JS, Lewkowicz AP, Konduru K et al. Pseudovirus rVSVΔG-ZEBOV-GP Infects Neurons in Retina and CNS, Causing Apoptosis and Neurodegeneration in Neonatal Mice. Cell Rep. 2019; 26(7):1718-26.e4. doi: 10.1016/j.celrep.2019.01.069. https://www.ncbi.nlm.nih.gov/pubmed/30759384
5. Ouyang W, Guo P, Takeda K, Fu Q, Fang H, Frucht DM. Erk1/2 inactivation promotes a rapid redistribution of COP1 and degradation of COP1 substrates. Proc Natl Acad Sci USA. 2020. doi: 10.1073/pnas.1913698117. https://www.ncbi.nlm.nih.gov/pubmed/32041890

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: Specific research areas include methods, tools, and models to identify correlates of protection, better evaluate medical countermeasure safety and potency, improve food safety, or developing references and methods to aid developers of diagnostic tests or medical countermeasures.

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[*] Including viruses and prions.

Microorganisms and/or Toxins Studied: Select Agents and Toxin (HHS, USDA), NIAID Category A pathogens, and simulants

Outdoor studies: No outdoor studies of biological aerosols were conducted.

National biological defence research and development programmes

1. What is the name of the facility?
Food and Drug Administration College Park Campus

Note: This facility is an addition in the 2019 CBM report.

2. Where is it located (include both address and geographical location)?
5001 Campus Drive, College Park, MD 20740

3. Floor area of laboratory areas by containment level (m^2):

BL2	304 m^2
BL3	0 m^2
BL4	0 m^2
Total laboratory floor area	304 m^2

4. The organizational structure of each facility.

(i)	**Total number of personnel**	12
(ii)	**Division of personnel**:	
	Military	0
	Civilian	12
(iii)	**Division of personnel by category**:	
	Scientists	12
	Engineers	0
	Technicians	0
	Administrative and support staff	0

(iv) List the scientific disciplines represented in the scientific/engineering staff.
Chemistry, Biochemistry, Biology, Food Technology, Microbiology, Genomics Microbiology

(v) Are contractor staff working in the facility? If so, provide an approximate number.
Yes. Number: 3, plus 1 visiting scientist

(vi) What is (are) the source(s) of funding for the work conducted in the facility, including indication if activity is wholly or partly financed by the Ministry of Defence?
Department of Health and Human Services (HHS)

(vii) What are the funding levels for the following programme areas:

Research	$759,049
Development	$0
Test and evaluation	$0
Total	$759,049

(viii) Briefly describe the publication policy of the facility:
FDA staff are encouraged to publish their research results in peer-reviewed scientific journals. The FDA review and clearance policy ensures publications are of high quality and vetted by subject matter experts

as well as leadership. In addition, compliance with the public access to federally-funded scientific research (including digital data and publications) is assured by following FDA's data management plan. The policy states that publications must be uploaded to PubMed Central one year after the publication date.

- FDA review and clearance policy: https://www.fda.gov/media/80061/download
- FDA Data Management Plan: (http://www.fda.gov/downloads/AboutFDA/ReportsManualsForms/StaffManualGuides/UCM479268.pdf)

(x) Provide a list of publicly-available papers and reports resulting from the work published during the previous 12 months. (To include authors, titles and full references.)

1. Mansfield MJ, Wentz TG, Zhang S, Lee EJ, Dong M, Sharma SK et al. Bioinformatic discovery of a toxin family in Chryseobacterium piperi with sequence similarity to botulinum neurotoxins. Sci Rep. 2019; 9(1):1634. doi: 10.1038/s41598-018-37647-8. https://www.ncbi.nlm.nih.gov/pubmed/30733520
2. Pillai SP, Prentice KW, Ramage JG, DePalma L, Sarwar J, Parameswaran N et al. Rapid Presumptive Identification of Bacillus anthracis Isolates Using the Tetracore RedLine Alert™ Test. Health Security. 2019;17(4):334-43. doi: 10.1089/hs.2019.0038. https://www.ncbi.nlm.nih.gov/pubmed/31433282
3. Prentice KW, DePalma L, Ramage JG, Sarwar J, Parameswaran N, Petersen J et al. Comprehensive Laboratory Evaluation of a Lateral Flow Assay for the Detection of Yersinia pestis. Health Security. 2019;17(6):439-53. doi: 10.1089/hs.2019.0094. https://www.ncbi.nlm.nih.gov/pubmed/31859568

5. Briefly describe the biological defence work carried out at the facility, including type(s) of micro-organisms[*] and/or toxins studied, as well as outdoor studies of biological aerosols.

Objectives: The FDA's Center for Food Safety and Applied Nutrition (CFSAN) is a national leader in protecting and promoting public health. Biodefense work at CFSAN is aimed at developing the tools essential for testing a broad array of food products for biological threats. The microbial genomics and analytical chemistry techniques developed at CFSAN are available to other Federal agencies charged with forensic investigations.

Microorganisms and/or Toxins Studied: HHS Select Agent and Toxin, NIAID Category A

Outdoor studies: No outdoor studies of biological aerosols were conducted.

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[*] Including viruses and prions.

Form B

BWC - Confidence Building Measure

Exchange of information on outbreaks of infectious diseases and similar occurrences caused by toxins

United States of America

April 15, 2020

Information on outbreaks of infectious diseases and similar occurrences, that seem to deviate from the normal pattern

Human Disease Events

Canine rabies importation from Egypt to the United States:

In February 2019 the U.S. Centers for Disease Control and Prevention (CDC) received a blood sample from a dog who bit a veterinary technician in Kansas, United States. The test was confirmed positive for rabies and the veterinary technician was given post-exposure prophylaxis. Unfortunately, the dog needed to be euthanized. The dog was part of a group of 26 dogs imported to the U.S. from Egypt via Canada. CDC tracked down the other dogs and placed them in a quarantine for 4 to 6 months to ensure they were not also infected with rabies. The dog was reportedly vaccinated in December 2018 and CDC worked with partners to investigate the information on the vaccine records. In May 2019, CDC announced a temporary ban on dog imports from Egypt in regard to this and two other cases since 2015. The United States eliminated dog rabies in 2007 and is working to prevent its reintroduction. https://www.cdc.gov/importation/bringing-an-animal-into-the-united-states/Egypt-dogs-temp-suspension.html

Multidrug resistant agents – United States:

In April 2019, the U.S. Centers for Disease Control and Prevention (CDC) investigated an outbreak of cases caused by an emerging multidrug-resistant strain of *Salmonella* Newport with decreased susceptibility to azithromycin that was first detected in 2016. The resistance pattern is concerning because the recommended antibiotics may not work. During June 2018–March 2019, 255 infections were reported among U.S. residents, including approximately 60% of infections that were acquired in the United States. Approximately 40% of patients reported visiting Mexico in the week before illness onset. A high proportion of non-travelers ate beef before illness onset (93%) and detection of the outbreak strain in U.S. beef indicates that beef was a likely source of infection in these patients. The outbreak strain was also detected in soft cheese brought back from Mexico, and a previous sample of beef imported from Mexico. The investigation indicated that dairy cattle in both countries could be a source of more infections with this strain. CDC had several calls with authorities in Mexico and Pan American Health Organization during the course of this investigation. https://www.cdc.gov/mmwr/volumes/68/wr/pdfs/mm6833-H.pdf

Human Infection with Influenza A (H1N1):

On May 3, 2019, an adult >65 years of age with multiple underlying medical conditions developed an influenza-like illness in Michigan. The patient sought medical care at an emergency department on May 5; and was admitted to the hospital as a result of their illness and a respiratory specimen obtained. This specimen was forwarded to the Michigan Department of Health and Human Services Bureau of Laboratories as part of routine surveillance activities. Real-time RT-PCR testing conducted at the public health laboratory was positive for a seasonal influenza A (H1N1)pdm09 virus. The specimen was then forwarded to the National Influenza Reference Center in Wisconsin per national surveillance specimen submission guidelines. Genetic sequencing results of the specimen were suggestive of an influenza A (H1N1) variant (A(H1N1)v) virus. The specimen was forwarded to CDC for additional testing. On May 30, CDC confirmed an A (H1N1)v virus using RT-PCR and genome sequence analysis of the specimen.

This is the first and only variant influenza virus identified in the United States during 2019. The patient has completely recovered. While no exposure to swine was reported, the virus had hemagglutinin and neuraminidase gene segments derived from the seasonal human influenza A (H1N1)pdm09 virus that were likely introduced into swine by a recent zoonosis and were closely related to influenza A(H1N1) viruses now circulating in the U.S. swine population.

Influenza A viruses that normally circulate in swine are called variant influenza viruses when isolated from humans. There may be important antigenic and genetic differences between seasonal influenza viruses that circulate worldwide in the human population and influenza viruses that normally circulate in swine. Since reporting of novel influenza A viruses became nationally notifiable in 2005, 22 human infections with A (H1N1)v, including this one, have been confirmed by CDC.

Influenza A viruses in swine do not usually infect humans, but rare human infections have been reported, usually after direct or indirect exposure to pigs. Since 2005, a total of 483 variant virus infections have been identified in the United States. There has been some limited, non-sustained human-to-human transmission of variant influenza viruses, but no ongoing community transmission has been identified.

Information regarding this A (H1N1)v case can be found at:
https://www.cdc.gov/flu/weekly/weeklyarchives2018-2019/Week21.htm.

General information about variant and influenza A viruses in swine are available at:
http://www.cdc.gov/flu/swineflu/index.htm and http://gis.cdc.gov/grasp/fluview/Novel_Influenza.html.

Animal Disease Events

Summary of Reports: In 2019, the United States submitted six World Organization for Animal Health (OIE) immediate reports for animal disease events. These included one low pathogenic notifiable avian influenza report, one rabbit hemorrhagic disease virus report, two infectious hypodermal and hematopoietic necrosis virus reports, one red sea bream iridoviral disease report, and one report for tilapia lake virus.

Event summaries can be found, by country and then year of occurrence, on the OIE website:
http://www.oie.int/wahis_2/public/wahid.php/Wahidhome/Home/indexcontent/newlang/en

2019 Immediate OIE Reports:

Avian Influenza (Infection with Avian Influenza Viruses)

Avian influenza (AI) is caused by influenza type A viruses, which can infect poultry (such as chickens, turkeys, pheasants, quail, domestic ducks, geese, and guinea fowl) and are carried by free-flying waterfowl such as ducks, geese, and shorebirds. AI viruses are classified by a combination of two groups of proteins: hemagglutinin or “H” proteins, of which there are 16 (H1-H16), and neuraminidase or “N” proteins, of which there are 9 (N1-N9). Many different combinations of “H” and “N” proteins are possible. Each combination is considered a different subtype, and each subtype can be further sub-classified as different strains. AI viruses are identified by their pathogenicity (low or high)—the ability of a particular virus strain to produce disease in domestic chickens. Any influenza A virus (including H5 and H7 avian influenza viruses) in its high pathogenic form is reportable in birds, but only H5 and H7 low pathogenic avian influenza viral infections in poultry are notifiable as per Chapter 10.4 on avian influenza of the OIE Terrestrial Animal Health Code (2019):
http://www.oie.int/index.php?id=169&L=0&htmfile=chapitre_avian_influenza_viruses.htm.

Low Pathogenic Avian Influenza (LPAI), H5N2—California

OIE Immediate Report April 4, 2019—Final Report September 9, 2019

As part of routine H5/H7 AI surveillance, H5 LPAI was detected in a commercial duck and goose breeder flock. The U.S. Department of Agriculture (USDA) Animal and Plant Health Inspection Service (APHIS) and the California Department of Food and Agriculture completed a comprehensive epidemiological investigation of this event. There were no clinical signs of illness or increased mortality on the premises. Hatchlings were euthanized and brood stock on the affected premises were monitored for clearance of AI virus. Twenty-one days after the first negative samples, the adult birds were moved from the affected barn to another barn on the premises; shipment of disinfected product and hatchlings under permit was allowed at this time. Sentinel ducks were placed in the affected barn then tested for AI virus 3 weeks later. AI virus was not detected in the sentinel birds and the premises was released from quarantine.

Infectious hypodermal and hematopoietic necrosis virus (IHHNV)

IHHNV infects penaeid shrimp and clinical presentation can vary depending on species, life stage, and population of shrimp affected. High mortalities, reduction in food consumption, changes in behavior or appearance, suppressed growth, and subclinical infection can all result from infection with IHHNV.

IHHNV—Texas and Florida

OIE Immediate Report June 13, 2019 — Final Report August 30, 2019

As part of routine sampling, IHHNV was detected in shrimp on two commercial premises in Texas and one commercial premises in Florida. USDA APHIS, the Texas Parks and Wildlife Department, and the Florida Department of Agriculture and Consumer Services completed a comprehensive epidemiological investigation of these events. Clinical signs consisting of delayed growth were seen in shrimp on one of the Texas premises; there were no clinical signs present in the other two affected premises. All affected shrimp were depopulated and their tanks were cleaned and disinfected.

IHHNV—California and New Mexico

OIE Immediate Report November 20, 2019 — Open at the end of 2019

A research facility in California and a commercial grow-out facility in New Mexico that sold shrimp for public consumption were determined to be IHHNV-positive. Both facilities received shrimp from a previously identified infected farm. The shrimp at both facilities had delayed growth and the shrimp at the grow-out facility also had increased mortality; the increased mortality may have been associated with a bacterial co-infection. USDA APHIS, the California Department of Fish and Wildlife, and the New Mexico Department of Agriculture conducted a comprehensive epidemiological investigation of these events. Both premises were quarantined, all shrimp on the premises were depopulated, and the facilities were cleaned and disinfected.

Rabbit Hemorrhagic Disease Virus-2 (RHDV-2)—Washington

OIE Immediate Report July 19, 2019—Open at the end of 2019

Rabbit hemorrhagic disease (RHD) is a highly contagious and fatal disease of rabbits. It is caused by RHD virus (RHDV), a Calicivirus. There are three recognized pathogenic groups: RHDV (aka RHDV1), RHDVa (considered a subtype of the classic RHDV), and RHDV2.

RHDV-2 was identified in non-commercial pet and feral European rabbits (*Oryctolagus cuniculus*) with high mortality rates in Washington. USDA APHIS and the Washington State Department of Agriculture are conducting a comprehensive epidemiological investigation and surveillance in response to this event.

Red Sea Bream Iridoviral Disease (RSIVD)—Missouri
OIE Immediate Report May 14, 2019—Final Report May 14, 2019

RSIVD affects red sea bream (*Pagrus major*) and more than 30 other species of farmed marine fish in the orders Perciformes and Pleuronectiformes. RSIVD is caused by the red sea bream iridovirus (RSIV) and by the infectious spleen and kidney necrosis virus. RSIV-infected fish are lethargic, severely anemic, have pale gills, gill petechiation, and splenomegaly. They may gasp due to the anemia. Mortality varies widely from 0 to 100 percent depending on fish species, age, physiological condition, water temperature, management practices, and environmental conditions.

The USDA APHIS National Veterinary Services Laboratories (NVSL) confirmed RSIV in imported ornamental fish (common clownfish or *Amphiprion ocellaris*) that were confined to an aquarium. The clownfish started showing clinical signs of disease during the quarantine period after arrival at the aquarium. Lionfish (*Pterois volitans*) that shared the same water at the aquarium with the imported clownfish were also found to be infected with RSIV. The infected fish were never released and were always under containment until euthanized.

Tilapia Lake Virus (TiLV)**—Colorado, Idaho, Wyoming**
OIE Immediate Report May 6, 2019—Final Report August 7, 2019

TiLV is a novel orthomyxovirus-like virus of tilapiine cichlids. All age groups are susceptible to infection with mortality ranging from 10 to 90 percent. Clinical signs are often associated with a concurrent bacterial infection and are not pathognomonic for TiLV. Infected fish have non-specific behavioral signs including lethargy and inappetence. External signs may include exophthalmia, corneal opacity, darkening of skin, skin ulcerations or hemorrhages (with scale loss), pale gills, and swollen abdomen. Internally, fish may have fluid accumulation in the coelomic cavity.

TiLV was detected in three multiple-age class commercial farms. USDA APHIS and the State Departments of Agriculture conducted a comprehensive epidemiological investigation of this event with surveillance. The epidemiological investigation determined that clinical signs consistent with TiLV were first observed on the index premises in November 2018. All clinically ill fish cohorts were depopulated. Exposed fish in the same sites were either depopulated or sent to terminal market. The affected holdings were cleaned and disinfected.

Form C

BWC - Confidence Building Measure

Encouragement of Publication of Results and Promotion of Use of Knowledge

United States of America

April 15, 2020

HealthData.gov https://healthdata.gov/	This site is dedicated to making data **discoverable** and making **valuable** government data available to the public in the hopes of better health outcomes for all. The data is collected and supplied from agencies from the U.S. Department of Health and Human Services as well as state partners. A full list of agencies contributing data is available on the site at: https://healthdata.gov/content/about Datasets/bundles which have been updated on November 2019: https://healthdata.gov/dataset/chemical-effects-biological-systems-cebs
Department of Health and Human Services - The Data Initiative https://www.hhs.gov/cto/initiatives/data-initiative/index.html	Across the U.S. Department of Health and Human Services (HHS), agencies collect a vast array of data to better understand the health of the nation. More than 2000 data sets collected by HHS for use by researchers and entrepreneurs have been publicly released. The Open Data movement continues to be a focus of the Department in order to make data available for the public to do research, develop applications, and create new products to improve health. The report on *Leveraging the Nation's Healthcare Data* (December 2019) outlines a vision for data sharing at HHS and presents a holistic approach to data sharing and change management necessary to enable a more evidence based organization. The report is available online at: https://www.hhs.gov/sites/default/files/master-future-state-508.pdf
Department of Health and Human Services – Stakeholder Engagement on Open Data *Roundtable on Sharing and Utilizing Health Data for AI Applications* on April 16, 2019; report available at: https://www.hhs.gov/sites/default/files/sharing-and-utilizing-health-data-for-ai-applications.pdf *Roundtable on Balancing Privacy with Health Data Access* on July 15, 2019; report available at: http://reports.opendataenterprise.org/RT2-Privacy-Report-Final.pdf	The U.S. Department of Health and Human Services (HHS) partnered with the independent nonprofit Center for Open Data Enterprise (CODE) to co-host a series of three Roundtables to find ways to improve how health data is shared and utilized for the public good, as follows:

Roundtable on Leveraging Data on the Social Determinants of Health, October 3, 2019; report available at: http://reports.opendataenterprise.org/Leveraging-Data-on-SDOH-Summary-Report-FINAL.pdf	
NIH U.S. National Library of Medicine https://clinicaltrials.gov/	ClinicalTrials.gov is a database of privately and publicly funded clinical studies conducted around the world (currently 328,725 research studies in all 50 U.S. states and in 209 countries). ClinicalTrials.gov allows the registration of clinical studies with human subjects that assess biomedical and/or health outcomes and that conform to: • Any applicable human subject or ethics review regulations (or equivalent); • Any applicable regulations of the national or regional health authority (or equivalent).
2018 Annual Report of the Federal Select Agent Program https://www.selectagents.gov/annualreport2018.html	The *2018 Annual Report of the Federal Select Agent Program*, released in January 2020, summarizes 2018 program data for the Federal Select Agent Program (FSAP), which regulates the possession, use and transfer of biological select agents and toxins so that important work with potentially dangerous and deadly pathogens can be conducted as safely and securely as possible. FSAP is a partnership between HHS's Centers for Disease Control and Prevention and USDA's Animal and Plant Health Inspection Service.
2018 Federal Select Agent Program Inspection Report Processing Annual Summary (29 October, 2019) https://www.selectagents.gov/resources/2018-FSAP-Inspection-Report-Processing-Annual-Summary_508.pdf	A report summarizing timeliness data related to Federeal Select Agent Program (FSAP) issued inspection reports for the FSAP January 1, 2018 – December 31, 2018.
Federal Select Agent Program (FSAP) Infographics (27 March, 2019) https://www.selectagents.gov/infographics-compliance.html	The Federal Select Agent Program (FSAP) regulates laboratories working with select agents and toxins and helps to ensure that lifesaving research conducted with these potentially dangerous materials is done as safely and securely as possible. FSAP can take action in order to protect public, animal, and plant health, using a number of available options to address any potential risks and bring the entity back into compliance with the regulations.

	The FSAP has developed a new series of infographics in order to describe these processes in more detail. • How the FSAP Addresses Serious Biosafety or Security Concerns • Theft or Loss of a Select Agent or Toxin • Release of a Select Agent or Toxin • About the FSAP
NIH Data Book https://report.nih.gov/nihdatabook/	The National Institutes of Health (NIH) Data Book provides basic summary statistics on extramural grants and contract awards, grant applications, the organizations that NIH supports, the trainees and fellows supported through NIH programs, and the national biomedical workforce.
DRAFT NIH Policy for Data Management and Sharing (November 2019) https://osp.od.nih.gov/scientific-sharing/nih-data-management-and-sharing-activities-related-to-public-access-and-open-science/	This Policy applies to all research, funded or conducted in whole or in part by National Institutes of Health (NIH),that results in the generation of scientific data. This includes research funded or conducted by extramural grants, contracts, intramural research projects, or other funding agreements regardless of NIH funding level or funding mechanism. The effective date of this Policy and subsequent implementation deadlines are dependent upon feedback on this proposal. To facilitate public comments, NIH has established a web-portal where people can easily and securely provide their feedback. Responses must be submitted no later than January 10, 2020.

Form E

BWC - Confidence Building Measure

Declaration of legislation, regulations and other measures

United States of America

April 15, 2020

Relating to	Legislation	Regulations	Other measures[*]	Amended since last year
(a) Development, production stockpiling, acquisition or retention of microbial or other biological agents, or toxins, weapons, equipment and means of delivery specified in Article I	Yes	Yes	Yes	Yes[1]
(b) Exports of micro-organisms[†] and toxins	Yes	Yes	Yes	Yes[2]
(c) Imports of micro-organisms[†] and toxins	Yes	Yes	Yes	Yes[3]
(d) Biosafety[‡] and biosecurity[§]	Yes	Yes	Yes	Yes[4]

EXPLANATORY NOTES

[1] (a) Development, production stockpiling, acquisition or retention of microbial or other biological agents, or toxins, weapons, equipment and means of delivery specified in Article I

- **2019-2022 National Health Security Strategy:** Provides a vision for strengthening the United States ability to prevent, detect, assess, prepare for, mitigate, respond to, and recover from 21st century health security threats and to strengthen the U.S. public health and health care systems to effectively and swiftly confront the devastating consequences of health security risks. For example, health security threats including the use of biological weapons, emerging infectious diseases that could lead to a pandemic, or catastrophic natural disasters and human-caused incidents. Read more at: https://www.phe.gov/Preparedness/planning/authority/nhss/Pages/default.aspx

- **Global Health Security Strategy (2019):** Outlines the United States Government's approach to strengthen global health security, including accelerating the capabilities of targeted countries to prevent, detect, and respond to infectious disease. It states that the United States Government will continue to collaborate with partners, including countries, multilateral organizations, and nongovernmental stakeholders through the Global Health Security Agenda (GHSA) to strengthen and sustain capacity to prevent, detect, and respond to infectious disease threats. This includes working with partners to make progress toward achieving 2005 International Health Regulations (IHR) core public health capacities while supporting implementation and compliance with the Biological Weapons Convention (BWC), United Nations Security Council Resolution 1540, World Organization for Animal Health Performance of Veterinary Services Pathway, and other international frameworks. Read more at: https://www.whitehouse.gov/wpcontent/uploads/2019/05/GHSS.pdf

[2] (b) Exports of micro-organisms and toxins:

- **U.S. Department of Commerce (DOC) Revisions to Country Group Designations for Venezuela and Conforming Changes for License Requirements:** In this final rule, DOC's Bureau of Industry and Security

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[*] Including guidelines.

[†] Micro-organisms pathogenic to man, animals and plants in accordance with the Convention.

[‡] In accordance with the latest version of the WHO Laboratory Biosafety Manual or equivalent national or international guidance.

[§] In accordance with the latest version of the WHO Laboratory Biosecurity Guidance or equivalent national or international guidance.

(BIS) amends the Export Administration Regulations (EAR) to remove Venezuela from Country Group B and adds Venezuela to Country Groups D:1-4, which list countries of national security concern, as well as of nuclear, chemical and biological weapons, and missile technology concerns. The changes in this final rule also better align the Country Group designations for Venezuela with other EAR national security-related provisions that already apply to Venezuela. Consistent with adding Venezuela to Country Group D:3, a license will now be required for the export or reexport of items subject to Export Control Classification Number (ECCN) 1C991.d to Venezuela. ECCN 1C991.d includes "medical products containing specified human and animal pathogens and "toxins." The license requirements for these items to all other countries have not changed. https://www.bis.doc.gov/index.php/documents/regulations-docs/federal-register-notices/federal-register-2019/2399-84-fr-24018/file

[3] (c) Imports of micro-organisms and toxins:

- **2019 Tools for the CDC Import Permit Program (IPP):** The IPP regulates infectious biological materials coming into the U.S. in order to prevent the introduction and spread of disease in humans. This helps to protect the health of laboratory workers and those in the surrounding communities. CDC developed an interactive e-tool (https://www.cdc.gov/cpr/ipp/etool.htm) and a fact sheet (https://www.cdc.gov/cpr/ipp/docs/DoYouNeedanImportPermitFactSheetFINAL.pdf) that can help potential applicants determine if a CDC import permit is needed. Read more at: https://www.cdc.gov/cpr/ipp/about.htm

[4] (d) Biosafety and biosecurity:

i. Amendments to Select Agent and Toxin Regulations:

- Biennial review: As required by the Bioterrorism Response Act, the Federal Select Agent Program (FSAP) reviews the list of select agents and toxins on at least a biennial basis. FSAP last republished the list of select agents and toxins in the *Federal Register* on January 19, 2017 (82 FR 6278 and 82 FR 6197). In 2019, FSAP initiated the review of the list of select agents and toxins.

ii. Select Agent and Toxin Regulations: Policy statements and regulatory interpretations:

- During 2019, FSAP generated the following policies:
  - Regulatory interpretation regarding requirement for inactivation certificates and intra-entity transfers (https://www.selectagents.gov/reg-int_certificates.html)
  - Regulatory interpretation regarding transferring excluded amounts of toxins (https://www.selectagents.gov/reg-int_excluded-transfer.html)

- Policy Statement on Annual Inspections Required by Section 9(a)(6) of the Select Agent Regulations: On March 22, 2019, FSAP published a policy statement to require a Responsible Official (RO) ensure that an annual inspection is conducted for each registered space where select agents and toxins are stored or used in order to determine compliance with the requirements of the select agent regulations. The policy statement outlines inspection requirements focused on biosafety and biocontainment plans, security plans, incident response plans, and training. The policy statement is effective March 22, 2019, and is available at https://www.selectagents.gov/policystatement_annualinspection.html. It replaces the FSAP Policy Statement: Entity Annual Internal Inspections Required by Section 9(a)(6) of the Select Agent Regulations dated August 9, 2018.

iii. Policy statements and regulatory interpretations concerning Select Agent and Toxin Regulations (Public Health Security and Bioterrorism Preparedness and Response Act of 2002

and the Agricultural Bioterrorism Protection Act of 2002 concerning the Federal Select Agent Program):

- During 2019, the Departments of Health and Human Services (HHS) and Agriculture (USDA) generated the following policies and regulatory interpretations:
    - Federal Select Agent Program Policy Statement: Entity Annual Internal Inspections Required by Section 9(a)(6) of the Select Agent Regulations (March 22, 2019); https://www.selectagents.gov/policystatement_annualinspection.html
    - Regulatory Interpretation regarding requirement for inactivation certificates and intra-entity transfers (May 17, 2019); https://www.selectagents.gov/reg-int_certificates.html
    - Regulatory interpretation regarding transfer of excluded toxins (17 June, 2019); https://www.selectagents.gov/reg-int_excluded-transfer.html

iv. Federal Select Agent Program Security and Biosafety Guidance Documents for the Regulated Community:

- Technical and Non-technical Updates to Resource Documents:

Federal Select Agent Program Responsible Official Resource Manual
The Responsible Official is the individual designated by the registered entity with the authority and responsibility to act on behalf of the entity to ensure compliance with the select agent regulations. In February 2019, FSAP revised the Responsible Official Resource Manual to remove the "Three Year Cycle of RO Tasks" section and reference FSAP's policy and guidance on annual internal inspections. The manual is available at https://www.selectagents.gov/rorm-changes.html.

Exclusion Guidance Document
FSAP oversees the use, possession, and transfer of select agents and toxins at registered entities throughout the United States. The select agent regulations provide criteria for the exclusion of select agents and toxins (See 42 CFR §§ 73.3, 73.4; 9 CFR §§ 121.3, 121.4; 7 CFR § 331.3). The Exclusion Guidance Document provides additional information to entities or individuals who request to exclude attenuated strains of select agents or select toxins modified to be less potent or toxic from the requirements of the select agent regulations. In July 2019, FSAP updated the Exclusion Guidance Document to include eFSAP information and to update links. The document is available at https://www.selectagents.gov/egd-changes.html.

Restricted Experiments Guidance
In July 2019, FSAP updated the Restricted Experiments Guidance to include eFSAP information and to update links. The guidance is available at https://www.selectagents.gov/re-intro.html.

v. Amendments to the *NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules* (*NIH Guidelines*):

- In April 2019**,** the Department of Health and Human Services (HHS)/National Institutes of Health (NIH) published revised NIH Guidelines to eliminate duplicative review and reporting requirements for human gene transfer protocols and to refocus the role of the NIH Recombinant DNA Advisory Committee (RAC)- now renamed the Novel and Exceptional Technology and Research Advisory Committee (NExTRAC)- to be closer to its original mandate – a transparent forum for science, safety, and ethics of emerging biotechnologies. The document is available at: https://osp.od.nih.gov/wp-content/uploads/NIH_Guidelines.pdf

- Additional Guidance on incident reporting (May 2019): The *NIH Guidelines for Research Involving Recombinant or Synthetic Nucleic Acid Molecules* (*NIH Guidelines*) states that "…any significant problems, violations of the *NIH Guidelines*, or any significant research-related accidents and illnesses" must be reported to NIH within 30 days. Additional guidance on incident reporting, including FAQs and an incident reporting template, can be found here: https://osp.od.nih.gov/biotechnology/faqs-on-incident-reporting/

vi. Other Measures to Advance Biosafety and Biosecurity in the United States:

- U.S. Government Guidance on *Managing Solid Waste Contaminated with a Category A Infectious Substance* (August *2019);* read more at: https://www.phe.gov/s3/BioriskManagement/biocontainment/Pages/waste-management.aspx

- 23 September 2019: CDC Received Designation as PAHO/WHO Collaborating Centre for Biosafety and Biosecurity; read more at: https://www.cdc.gov/media/releases/2019/p0923-collaborating-centre.html

- Under the HHS *Framework for Guiding Funding Decisions about Proposed Research Involving Enhanced Potential Pandemic Pathogens* (P3CO Framework)- https://www.phe.gov/s3/dualuse/Documents/p3co.pdf HHS/ASPR led the multidisciplinary pre-funding review of research projects involving potential pandemic pathogens (PPPs). Read more at: https://www.phe.gov/s3/dualuse/Pages/Two-Research-Projects-PPP.aspx

- FBI Enforcement of BWC Article I: Signed into law in 1990, the Biological Weapons Anti-terrorism (BWAT) Act implements provisions of the BWC and violations are investigated and prosecuted as federal crimes. The BWAT Act was codified in the U.S. federal criminal code (Title 18 of the United States Code, Section 175(a), 175(b), and 175b; also referred to as 18 USC 175). As a result, individual(s) in the United States can be charged with a federal crime if they use a biological agent, toxin, or delivery system as a weapon, or are in possession of any biological agent without a justifiable research or peaceful purpose. It is also a crime to knowingly possess a Biological Select Agent or Toxin, regardless of intent, if the individual does not have legitimate access (registered with the U.S. Federal Select Agent Program) and purpose. In 2019, the FBI responded to several incidents that involved biological material and led investigations that resulted in prosecutions for the violation of 18 USC 175.

- Amendment to Title 18 USC 175b**:** In July 2019, an amendment to 18 USC 175b was signed into law, known as the Effective Prosecution of Possession of Biological Toxins and Agents Act of 2019 (https://www.congress.gov/116/plaws/publ31/PLAW-116publ31.pdf). This corrected a previous oversight excluding a number of toxins affecting the effective prosecution of individuals, including ricin and tetrodotoxin.

- FBI Security Risk Assessments (SRAs) – 3,629 SRAs Completed in 2019: The FBI conducts Security Risk Assessments (SRAs), a requirement of the U.S. Federal Select Agent Program (FSAP), on all entities and personnel in the United States requesting possession, use, or transfer of biological select agents and toxins (BSAT). Using various biographical and biometric databases, the FBI determines if a candidate meets the criteria of a "restricted person" based upon a list of prohibitors found under 18 U.S. Code 175b (derived from the USA PATRIOT Act and the Public Health Security and Bioterrorism Preparedness and Response Act). In 2019, 3,629 SRAs were processed by the FBI (Criminal Justice Information Services Division, Bioterrorism Risk Assessment Group). Of the 3,629 individual SRAs processed, 30 BSAT access candidates were determined to meet the criteria of a "restricted person." The FBI's adjudication is provided to the Department of Health and Human Services or the Department of Agriculture, who decides whether to grant or deny the requesting entity or individual access to BSAT.

- FBI Biosecurity Outreach: During 2019, the FBI conducted over twenty biosecurity outreach events at public and private research institutions across the United States. These engagements provided an environment where law enforcement (the FBI and State and local law enforcement agencies) and the research communities (research students, professors/researchers, biosafety officers, etc.) could engage in mutually beneficial dialogue. During these events, the FBI aimed to: 1) improve situational awareness of biosecurity threats, and 2) foster a mechanism for to report suspicious activities. The FBI works to enhance the science community's awareness of threats and vulnerabilities, both internal and external, as scientists could be exploited because of their expertise and access to biological material/technologies. The FBI also educates the science community of the FBI's roles and responsibilities in the biosecurity arena and provides resources that can be used to mitigate suspicious activities.

  In addition, the FBI conducted biosecurity engagements with both the international synthetic biology sector and the amateur biology community in the United States. Engagements include attendance at conferences and regional meetings, FBI-sponsored national and international workshops, assistance in the development of safety and security framework, and dissemination of education materials. For example, during 2019, the FBI participated in security discussions with domestic and international synthetic biology stakeholders, as well as sponsored and conducted biosecurity outreach at the 2019 International Genetically Engineered Machine Competition, the largest, annual synthetic biology meeting of undergraduate students worldwide. The FBI also provided training on Food Defense and on multi-sectoral approaches to determine if disease outbreaks in humans, plants, and/or animals could be from other than natural occurrences.

Form F

BWC - Confidence Building Measure

Declaration of Past Activities in Offensive and/or Defensive Biological Research and Development Programmes

United States of America

April 15, 2020

Form F

Declaration of Past Activities in Offensive and/or Defensive Biological Research and Development Programmes

1. **Date of entry into force of the Convention for the State party**
   26 March 1975

2. **Past offensive biological research and development programmes:**
   Nothing new to declare

Form G

BWC - Confidence Building Measure

Declaration of Vaccine Production Facilities

United States of America

April 15, 2020

Form G

Declaration of vaccine production facilities

The U.S. Food and Drug Administration publishes a current list of human vaccines licensed in the United States, including associated production facilities. This list is available at: http://www.fda.gov/BiologicsBloodVaccines/Vaccines/ApprovedProducts/ucm093833.htm.

Data provided on CBM Form G are excerpted from the publicly available website listed above (as accessed on February 14, 2020). Trade names are included when provided by the manufacturer. Specific and current information about a vaccine, and contact information for the manufacturer, are available by following the hyperlinks provided on the above website.

Form G

Declaration of vaccine production facilities

1. Name of facility
Barr Laboratories, Inc.

2. Location (Mailing Address)
1235 Mays Mill Road,
Forrest, Virginia 24551

3. General description of the types of diseases covered:
Acute respiratory disease caused by Adenovirus Type 4 and Type 7

Vaccines:

- Adenovirus Type 4 and Type 7 Vaccine, Live, Oral

Form G

Declaration of vaccine production facilities

1. Name of facility
Emergent Biosolutions

2. Location (Mailing Address)
3500 N. Martin Luther King Jr. Blvd.
Lansing, Michigan 48906

3. General description of the types of diseases covered:
Anthrax disease caused by *Bacillus anthracis* and smallpox disease

Vaccines:

- Anthrax Vaccine Adsorbed - [Biothrax]
- Smallpox (Vaccinia) Vaccine, Live -[ACAM2000]

Form G

Declaration of vaccine production facilities

1. Name of facility
MassBiologics

2. Location (Mailing Address)
University of Massachusetts Medical School
Boston, Massachusetts 02130

3. General description of the types of diseases covered:
Diphtheria and tetanus caused by *Corynebacterium diphtheriae* and *Clostridium tetani*.

Vaccines:

- Tetanus and Diphtheria Toxoids Adsorbed - [TDVAX]

Form G

Declaration of vaccine production facilities

1. Name of facility

MCM Vaccine Company/Sanofi Pasteur, Inc.

2. Location (Mailing Address)

1 Discovery Drive
Swiftwater, PA 18370

3. General description of the types of diseases covered:

Diphtheria, tetanus, pertussis, poliomyelitis, hepatitis B, and invasive disease due to *Haemophilus influenzae* type b.

Vaccines:

- Diphtheria and Tetanus Toxoids and Acellular Pertussis Adsorbed, Inactivated Poliovirus, Haemophilus b Conjugate [Meningococcal Protein Conjugate] and Hepatitis B [Recombinant] Vaccine - [VAXELIS]

Form G

Declaration of vaccine production facilities

1. Name of facility
Merck Sharp & Dohme Corp.

2. Location (Mailing Address)
PO Box 1000, UG2D-68
North Wales, Pennsylvania 19454

3. General description of the types of diseases covered:
Ebola virus disease, Invasive disease caused by *Haemophilus influenzae* type b; infection caused by all known subtypes of hepatitis B virus; Hepatitis A disease; cervical, vulvar and vaginal cancer and certain other diseases caused by Human Papillomavirus (HPV); Measles; Mumps; diseases caused by *Streptococcus pneumoniae*; Rotavirus disease; Rubella (German measles) disease; Varicella disease caused by the varicella-zoster virus (VZV); Herpes zoster (shingles) disease.

Vaccines:

- Ebola Zaire Vaccine, Live - [ERVEBO]
- Haemophilus b Conjugate Vaccine (Meningococcal Protein Conjugate) - [PedvaxHIB]
- Hepatitis A Vaccine, Inactivated - [VAQTA]
- Hepatitis B Vaccine (Recombinant) - [RECOMBIVAX HB]
- Human Papillomavirus Quadrivalent (Types 6, 11, 16, 18) Vaccine, Recombinant - [Gardasil]
- Human Papillomavirus 9-valent Vaccine, Recombinant - [Gardasil 9]
- Measles, Mumps, and Rubella Virus Vaccine, Live - [M-M-R II]
- Measles, Mumps, Rubella and Varicella Virus Vaccine Live - [ProQuad]
- Pneumococcal Vaccine, Polyvalent - [Pneumovax 23]
- Rotavirus Vaccine, Live, Oral, Pentavalent - [RotaTeq]
- Varicella Virus Vaccine Live - [Varivax]
- Zoster Vaccine, Live - [Zostavax]

Form G

Declaration of vaccine production facilities

1. Name of facility
Organon Teknika Corporation, LLC

2. Location (Mailing Address)
100 Rodolphe Street
Building 1300
Durham, North Carolina 27712

3. General description of the types of diseases covered:
For the prevention of tuberculosis

Vaccines:

- BCG Live **-** [BCG Vaccine]

Form G

Declaration of vaccine production facilities

1. Name of facility
Protein Sciences Corporation

2. Location (Mailing Address)
1000 Research Parkway
Meriden, Connecticut 06450-7159

3. General description of the types of diseases covered:
Disease caused by influenza virus subtypes A and B

Vaccines:

- Influenza Vaccine (Trivalent) - [Flubok]
- Influenza Vaccine (Quadrivalent) - [Flubok Quadrivalent]

Form G

Declaration of vaccine production facilities

1. Name of facility
Sanofi Pasteur, Inc.

2. Location (Mailing Address)
1 Discovery Drive
Swiftwater, PA 18370

3. General description of the types of diseases covered:
Dengue disease caused by dengue virus serotypes 1, 2, 3 and 4; influenza disease caused by pandemic (H1N1) 2009 virus; influenza disease caused by H5N1 subtype; influenza disease caused by influenza virus subtype A and type B; invasive meningococcal disease caused by Neisseria meningitidis serogroups A, C, Y and W-135; invasive meningococcal disease caused by Neisseria meningitidis serogroups A, C, Y, and W-135; and yellow fever acute viral illness caused by a mosquito-borne flavivirus

Vaccines:

- Dengue Tetravalent Vaccine, Live - [DENGVAXIA]
- Influenza A (H1N1) 2009 Monovalent Vaccine
- Influenza Virus Vaccine, H5N1
- Influenza Virus Vaccine (Trivalent, Types A and B) - [Fluzone, Fluzone High-Dose, and Fluzone Intradermal]
- Influenza Virus Vaccine (Quadrivalent, Types A and Types B) - [Fluzone Quadrivalent]
- Meningococcal (Groups A, C, Y and W-135) Polysaccharide Diphtheria Toxoid Conjugate Vaccine - [Menactra]
- Meningococcal Polysaccharide Vaccine, Groups A, C, Y and W-135 Combined - [Menomune-A/C/Y/W-135]
- Yellow Fever Vaccine - [YF-Vax]

Form G

Declaration of vaccine production facilities

1. Name of facility

Seqirus Inc.

2. Location (Mailing Address)

Seqirus Inc.
475 Green Oaks Parkway
Holly Springs, NC 27540

3. General description of the types of diseases covered:

Influenza

Vaccines:

- Influenza A (H5N1) Monovalent Vaccine, Adjuvanted - [AUDENZ]
- Influenza Vaccine, Adjuvanted - [FLUAD and FLUAD QUADRIVALENT]
- Influenza Vaccine – [Flucelvax Quadrivalent]
- Influenza Virus Vaccine (Trivalent, Types A and B) - [Flucelvax]

Form G

Declaration of vaccine production facilities

1. Name of facility

Wyeth Pharmaceuticals, Inc

2. Location (Mailing Address)

Pfizer, Inc.,
401 N. Middletown Road
Pearl River, New York 10965

3. General description of the types of diseases covered:

Invasive disease caused by *Streptococcus pneumoniae* serotypes 1, 3, 4, 5, 6A, 6B, 7F, 9V, 14, 18C, 19A, 19F and 23F and otitis media caused by S. pneumoniae serotypes 4, 6B, 9V, 14, 18C, 19F, and 23F, and invasive disease caused by *Neisseria meningitides* serogroup B.

Vaccines:

- Meningococcal Group B Vaccine - [TRUMENBA]
- Pneumococcal 13-valent Conjugate Vaccine (Diphtheria CRM197 Protein) - [Prevnar 13]

Biological Select Agents and Toxins

Biological Select Agents and Toxins are biological pathogens and toxins that the United States has determined have the potential to pose a severe threat to public health and safety, animal and plant health, or animal and plant products. The possession, use, and transfer of these agents is regulated by the U.S. Department of Health and Human Services (HHS) Centers for Disease Control and Prevention and the U.S. Department of Agriculture Animal and Plant Health Inspection Service under the Select Agent Regulations found in Part 73 of Title 42 of the Code of Federal Regulations, Part 331 of Title 7 of the Code of Federal Regulations, and Part 121 of Title 9 of the Code of Federal Regulations. Information on Biological Select Agents and Toxins can be found on the National Select Agent Registry website: http://www.selectagents.gov.

HHS Select Agents and Toxins

Abrin
Bacillus cereus Biovar *anthracis*
Botulinum neurotoxins
Botulinum neurotoxin-producing species of *Clostridium*
Conotoxins (alpha)
Coxiella burnetii
Crimean-Congo haemorrhagic fever virus
Diacetoxyscirpenol
Eastern Equine Encephalitis virus
Ebola virus
Francisella tularensis
Lassa fever virus
Lujo virus
Marburg virus
Monkeypox virus
Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments (Reconstructed 1918 Influenza virus)
Ricin
Rickettsia prowazekii
SARS-associated coronavirus (SARS-CoV)
Saxitoxin
South American Haemorrhagic Fever viruses: Chapare, Guanarito, Junin, Machupo, Sabia
Staphylococcal enterotoxins (A, B, C, D, E subtypes)
T-2 toxin
Tetrodotoxin
Tick-borne encephalitis complex (flavi) viruses: Far Eastern Tick-borne encephalitis, Siberian subtype, Kyasanur Forest disease, Omsk Hemorrhagic Fever
Variola major virus (Smallpox virus)
Variola minor virus (Alastrim)
Yersinia pestis

OVERLAP Select Agents and Toxins

Bacillus anthracis
Bacillus anthracis Pasteur strain
Brucella abortus

Brucella melitensis
Brucella suis
Burkholderia mallei (formerly *Pseudomonas mallei*)
Burkholderia pseudomallei (formerly *Pseudomonas pseudomallei*)
Hendra virus
Nipah virus
Rift Valley fever virus
Venezuelan Equine Encephalitis virus

USDA Select Agents and Toxins
African horse sickness virus
African swine fever virus
Avian influenza virus (highly pathogenic)
Classical swine fever virus
Foot-and-mouth disease virus
Goat pox virus
Lumpy skin disease virus
Mycoplasma capricolum subspecies *capripneumoniae* (contagious caprine pleuropneumonia)
Mycoplasma mycoides subspecies mycoides small colony (*Mmm* SC) (contagious bovine pleuropneumonia)
Newcastle disease virus (virulent virus serotype1)
Peste des petits ruminants virus
Rinderpest virus
Sheep pox virus
Swine vesicular disease virus

USDA PLANT PROTECTION AND QUARANTINE (PPQ) Select Agents and Toxins
Coniothyrium glycines (formerly Phoma glycinicola and Pyrenochaeta glycines)
Peronosclerospora philippinensis (Peronosclerospora sacchari)
Ralstonia solanacearum
Rathayibacter toxicus
Sclerophthora rayssiae
Synchytrium endobioticum
Xanthomonas oryzae

NIAID Category A, B, and C Priority Pathogens

The National Institute of Allergy and Infectious Disease (NIAID) categorization of pathogens identifies specific pathogens as priorities for additional research efforts as part of the NIAID biodefense research agenda.

Additional information on NIAID Category A, B, and C Priority Pathogens is available at: https://www.niaid.nih.gov/research/emerging-infectious-diseases-pathogens

Category A pathogens are those organisms/biological agents that pose the highest risk to national security and public health because they

- Can be easily disseminated or transmitted from person to person
- Result in high mortality rates and have the potential for major public health impact
- Might cause public panic and social disruption
- Require special action for public health preparedness

Category A Priority Pathogens

Bacillus anthracis (anthrax)
Clostridium botulinum toxin (botulism)
Yersinia pestis (plague)
Variola major (smallpox) and other related pox viruses
Francisella tularensis (tularemia)
Viral hemorrhagic fevers: Arenaviruses (Junin virus, Machupo virus, Guanarito virus, Chapare virus, Lassa virus, and Lujo virus); Bunyaviruses (Hantaviruses, Rift Valley Fever virus, Crimean Congo Hemorrhagic Fever virus); Flaviruses (Dengue virus); Filoviruses (Ebola, Marburg viruses)

Category B pathogens are the second highest priority organisms/biological agents. They

- Are moderately easy to disseminate
- Result in moderate morbidity rates and low mortality rates
- Require specific enhancements for diagnostic capacity and enhanced disease surveillance

Category B Priority Pathogens

Burkholderia pseudomallei (melioidosis)
Coxiella burnetii (Q fever)
Brucella species (brucellosis)
Burkholderia mallei (glanders)
Chlamydia psittaci (Psittacosis)
Ricin toxin (*Ricinus communis*)
Epsilon toxin (*Clostridium perfringens*)
Staphylococcus enterotoxin B (SEB)
Typhus fever (*Rickettsia prowazekii*)
Food- and Waterborne Pathogens

- Bacteria: Diarrheagenic *E.coli*, Pathogenic Vibrios, *Shigella* species, Salmonella, *Listeria monocytogenes, Campylobacter jejuni, Yersinia enterocolitica*
- Viruses: Caliciviruses, Hepatitis A virus
- Protozoa: *Cryptosporidium parvum*, *Cyclospora cayatanensis, Giardia lamblia*, *Entamoeba histolytica*, *Toxoplasma gondii*, *Naegleria fowleri*, *Balamuthia mandrillaris*
- Fungi: Microsporidia

Mosquito-born viruses: West Nile Virus, LaCrosse encephalitis virus, California encephalitis virus, Venezuelan equine encephalitis virus, Eastern equine encephalitis virus, Western equine encephalitis virus, Japanese encephalitis virus, St. Louis encephalitis virus, Yellow fever virus, Chikungunya virus, Zika virus

Category C pathogens are the third highest priority and include emerging pathogens that could be engineered for mass dissemination in the future because of

- Availability
- Ease of production and dissemination
- Potential for high morbidity and mortality rates and major health impact

Category C Priority Pathogens

Emerging infectious disease threats such as Nipah virus, Hendra virus, and additional hantaviruses

Tickborne hemorrhagic fever viruses such as Bunyaviruses (Severe Fever with Thrombocytopenia Syndrome virus, Heartland virus) and Flaviviruses (Omsk Hemorrhagic Fever virus, Alkhurma virus, Kyasanur Forest virus)

Tickborne encephalitis complex flaviviruses (Tickborn encephalitis virus, European subtype, Far Eastern subtype, Siberian subtype, Powassan/Deer Tick virus)

Tuberculosis, including drug-resistant TB

Influenza virus

Other Rickettsias

Rabies virus

Prions

Coccidioides spp.

Severe acute respiratory syndrome associated coronavirus (SARS-CoV), MERS-CoV, and other highly pathogenic human corona viruses

Antimicrobial resistance, excluding research on sexually transmitted organisms, unless the the resistance is newly emerging[*]

- Research on mechanisms of antimicrobial resistance
- Studies of the emergence and/or spread of antimicrobial resistance genes within pathogen populations
- Studies of the emergence and/or spread of antimicrobial-resistant pathogens in human populations
- Research on therapeutic approaches that target resistance mechanisms
- Modification of existing antimicrobials to overcome emergent resistance

Antimicrobial research, as related to engineered threats and naturally occurring drug-resistant pathogens, focused on development of broad-spectrum antimicrobials

Immunology studies that advance our understanding of host defenses applicable to the biodefense effort, for example: Adjuvants, Innate Immunity, Adaptive Immunity, Mucosal Immunity

Additional Emerging Infectious Diseases/Pathogens: Acanthamebiasis, Anaplasmosis, Australian bat lyssavirus, *Babesia*, atypical, *Bartonella henselae*, BK virus, *Bordetella pertussis*, *Borrelia mayonii*, *Borrelia miyamotoi*, Ehrlichiosis, Enterovirus 68, Enterovirus 71, Hepatitis C, Hepatitis E, Human herpesvirus 6, Human herpesvirus 8, JC virus, Leptospirosis, Mucormycosis, Poliovirus, Rubeola (measles), *Streptococcus* Group A

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[*] NIAID Category C Antimicrobial Resistance—Sexually Transmitted Excluded Organisms: Bacterial vaginosis, *Chlamydia trachomatis*, Cytomegalovirus, *Granuloma inguinale*, *Hemophilus ducreyi*, Hepatitis B virus, Hepatitis C virus, Herpes Simplex virus, Human immunodeficiency virus, Human papillomavirus, *Treponema pallidum*, *Trichomonas vaginalis*

Appendix B

Compiled list of microorganisms and toxins used for biodefense research

MICROORGANISM	CATEGORY
African horse sickness virus	USDA Select Agent
African swine fever virus	USDA Select Agent
Avian influenza virus (highly pathogenic)	USDA Select Agent
Bacillus anthracis	Overlap Select Agent + NIAID Category A
Bacillus anthracis Pasteur strain	Overlap Select Agent
Bacillus anthracis Sterne Strain	Simulant
Bacillus cereus Biovar anthracis	HHS Select Agent
Brucella abortus	Overlap Select Agent
Brucella melitensis	Overlap Select Agent
Brucella suis	Overlap Select Agent
Burkholderia mallei	Overlap Select Agent
Burkholderia pseudomallei	Overlap Select Agent
Chapare virus	HHS Select Agent
Classical swine fever virus	USDA Select Agent
Clostridium species producing botulinum neurotoxin	HHS Select Agent + NIAID Category A
Coniothyrium glycines	PPQ Select Agent
Coxiella burnetti	HHS Select Agent
Crimean-Congo hemorrhagic fever virus	HHS Select Agent
Dengue virus	NIAID Category A
Eastern equine encephalitis virus	HHS Select Agent
Ebola virus	HHS Select Agent + NIAID Category A
Foot-and-mouth disease virus	USDA Select Agent
Francisella tularensis	HHS Select Agent + NIAID Category A
Goatpox virus	USDA Select Agent
Guanarito virus	HHS Select Agent + NIAID Category A
Hantaviruses	NIAID Category A
Hendra virus	Overlap Select Agent
Influenza A virus, reconstructed replication-competent pandemic 1918 strains	HHS Select Agent
Junin virus	HHS Select Agent + NIAID Category A
Kyasanur Forest disease virus	HHS Select Agent
Lassa virus	HHS Select Agent + NIAID Category A
Lujo virus	HHS Select Agent
Lumpy skin disease virus	USDA Select Agent
Lymphocytic choriomeningitis virus	NIAID Category A
Machupo virus	HHS Select Agent + NIAID Category A
Marburg virus	HHS Select Agent + NIAID Category A
Monkeypox virus	HHS Select Agent
Mycoplasma mycoides	USDA Select Agent
Newcastle disease virus	USDA Select Agent
Nipah virus	Overlap Select Agent
Omsk hemorrhagic fever virus	HHS Select Agent

Rathayibacter toxicus	PPQ Select Agent
Rickettsia prowazekii	HHS Select Agent
Rift Valley fever virus	Overlap Select Agent + NIAID Category A
Sabia virus	HHS Select Agent
Severe acute respiratory syndrome-related coronavirus	HHS Select Agent
Tick-borne encephalitis complex flavivirus, Far Eastern subtype	HHS Select Agent
Tick-borne encephalitis complex flavivirus, Siberian subtype	HHS Select Agent
Variola major virus	HHS Select Agent + NIAID Category A
Variola minor virus	HHS Select Agent
Venezuelan equine encephalitis virus	Overlap Select Agent
Yersinia pestis	HHS Select Agent + NIAID Category A
TOXINS	**CATEGORY**
Abrin	HHS Select Toxin
Alpha conotoxins (Short, paralytic alpha conotoxins containing the following amino acid sequence X1CCX2PACGX3X4X5X6CX7)	HHS Select Toxin
Botulinum neurotoxins	HHS Select Toxin
Diacetoxyscirpenol	HHS Select Toxin
Ricin	HHS Select Toxin
Saxitoxin	HHS Select Toxin
Staphylococcal enterotoxins A, B, C, D, E subtypes	HHS Select Toxin
T-2 toxin	HHS Select Toxin
Tetrodotoxin	HHS Select Toxin